American Journal of Orthodontics and Oral Surgery.

Official Publication of the American Association of Orthodontists,
Its Component Societies, and
The American Board of Orthodontics

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VOLUME 34

JANUARY—DECEMBER, 1948

Office of the Editor: 8015 Maryland Avenue, St. Louis
Published by The C. V. Mosby Company, St. Louis

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Printed in the
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Milo Hellman Memorial Number

AMERICAN JOURNAL OF ORTHODONTICS

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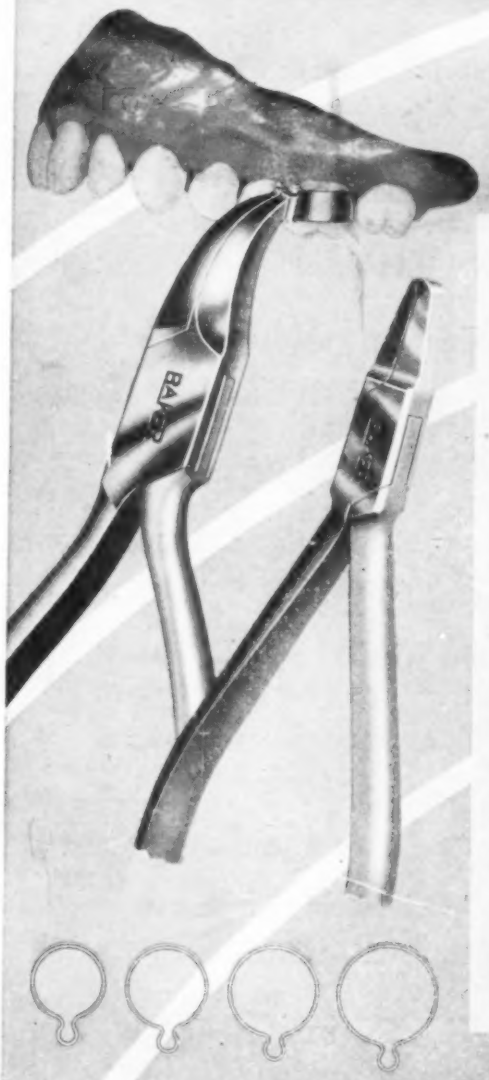

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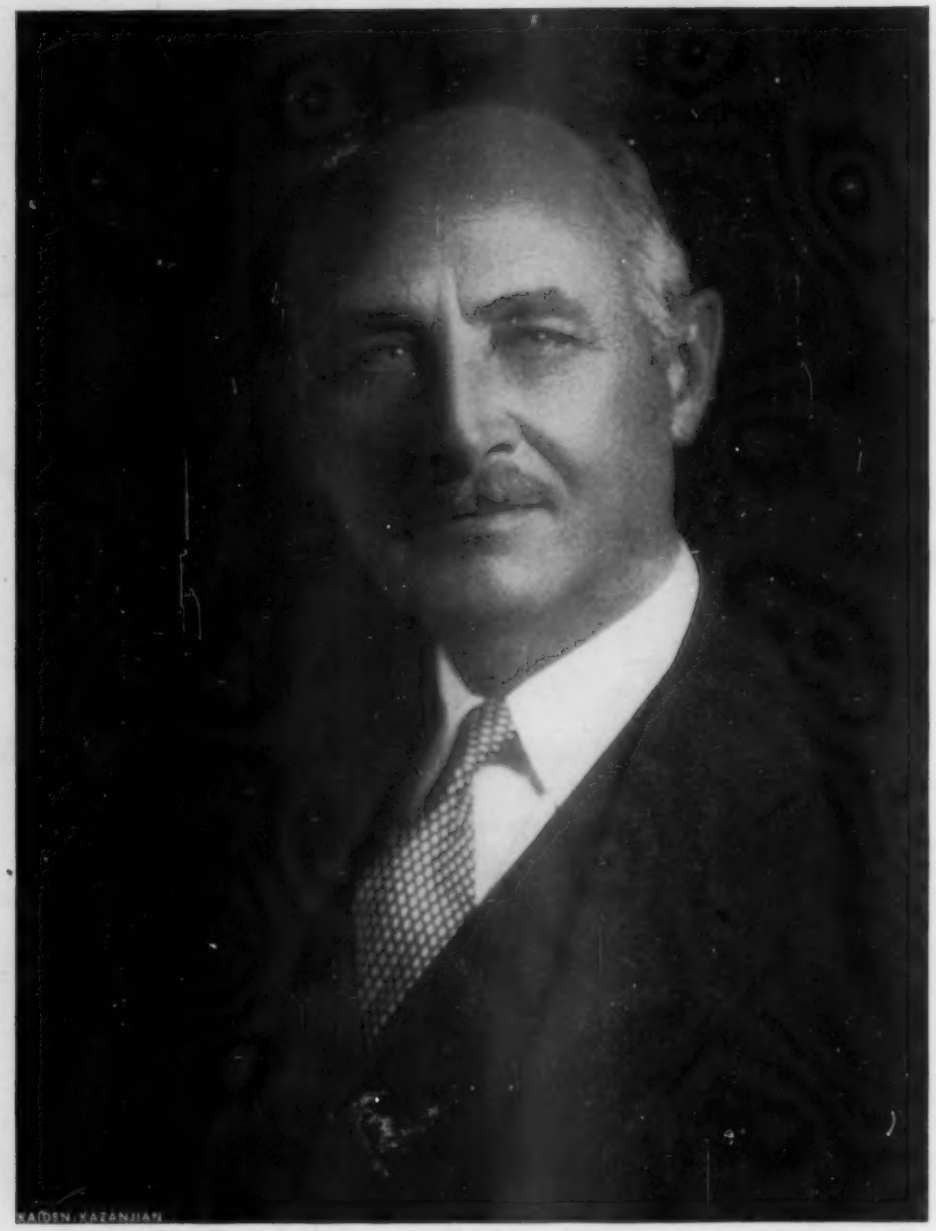

Milo McClusan

American Journal
of
ORTHODONTICS

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VOL. 34 JANUARY, 1948 NO. 1

Milo Hellman Memorial Number

THE FUTURE OF ORTHODONTIA: A PRESENT-DAY PROBLEM FOR THE ORTHODONTIST*

MILO HELLMAN†

TO THE relief of most of those present I shall not read this paper as it was presented in 1925. An abstract of it will quite suffice to make the points which in my estimation still seem to be valid. I shall then add some new facts derived from more recent observations and experiences, and point out the course now open for those who are desirous of leaving orthodontia behind them in a more secure state than the present outlook forebodes. Most of the recent historic facts of orthodontia which are of interest are quite well known to the members of this Society. Every one of them played an important part in the development of this specialty. It would, therefore, be presumptuous to repeat many of them. But, since a definite objective is aimed at now, I shall repeat some of the outstanding incidents leading to the present situation. One of the facts which may stand repetition is that, though records of orthodontic endeavors date back to Celsus, some 2,100 years ago, there is no indication of any effort toward an ultimate goal. The practice of orthodontia, or what may seem now to have resembled it, was not an entity, it had no special place, and was heading in no particular direction.

The practice of tampering with the teeth is perhaps as old as the emergence of an esthetic sense. It was probably the capacity of intuitively appreciating the beautiful in nature and art that prompted man to modify the natural ap-

At a meeting of the Eastern Association of Graduates of the Angle School of Orthodontia, Feb. 1, 1925, a paper of the same title was presented. On Feb. 10, 1936, the original paper, not having been published, was rewritten at the request of members. This time, Dr. Hellman felt that it would be repetitious to read certain parts of the original paper. However, in editing the manuscript, it was thought advisable to reinsert the material from the original paper, and it has been placed in brackets.—*Editors.*

*Edited by Professor William K. Gregory, Dr. B. W. Weinberger, and Edith Hellman Bull.

†Late Professor of Dentistry, School of Dental and Oral Surgery, Columbia University, New York; Research Associate in Physical Anthropology, American Museum of Natural History, New York.

pearance in form or arrangement of his teeth. Function was obviously irrelevant at first. It might even be conjectured that, on the one hand, attention to teeth was at first drawn by their absence. The earliest evidences of dental art are devices intended to replace missing teeth. Obviously, lacking them was not agreeable, at least to some. On the other hand, the continuity of the dental arch may have been distasteful to others. Some uncivilized people even today apparently cherish a break in the tooth row. They produce it intentionally by eliminating one or more of the most conspicuous teeth. Among Australian aboriginals and African natives, mutilation of the dentition by knocking out one or more of the incisor teeth is a ritual performed with joy and borne with pride. In either case, it could hardly be maintained that removing or replacing teeth has anything to do with function.

Another form of primitive and perhaps also ancient dental art is the mutilation of individual teeth. There are several forms in which this practice is exercised. It can hardly be said that whatever the form this practice assumed it is very probable that the objective was entirely esthetic, since there is absolutely no relationship with function. It was probably much later that crooked teeth first attracted any attention. It is not stretching the imagination to assume that observation follows experience. The first observation of crooked teeth must have come with some experience in doing something with them. The advice of Celsus (A.D. 50) that a misplaced tooth "when it is erupting" should be "pushed toward its place" indicates that the risk of teeth taking wrong positions was great. But he also advises the use of the finger for pushing it into place. This shows an objective and a technique to gain it which, of course, was acquired by previous experiences.

The practice of orthodontia, or what the old-fashioned regulating of teeth is now often charitably called, is as old as the available records of history are able to divulge. It obviously got its start from individual concern about the appearance of irregular teeth and the desire to do something about it. In the 2,000 years preceding its formal establishment as a specialty in the realm of dentistry, there is no particular event which indicates any significant trends toward definite goals. Besides the accumulation of records of individual experiences in the tasks of coping with irregularities of teeth, history does not point out any significant event which might have played an important part in the evolution of this specialty. From the very beginning of recorded history to the early part of this century, this branch of dentistry seems to have been composed of energetic pioneers who were thoroughly impressed with the spirit of "rugged individualism" to use a modern politico-economic phrase.

It was at the beginning of this century that Angle showed the courage of his convictions when, in the face of many obstacles, he established orthodontia as an independent specialty. "Having become entirely discouraged," writes Angle, "with my experiences in dental colleges, I became filled with the belief that if orthodontia was to make any material progress, a separate school entirely independent of dental schools must be formed, which would amply provide opportunity for those with aptitude and liking for the subject to study in a broad, thorough and comprehensive manner, and where it would be relieved

from all blighting, handicapping influences which are necessarily thrown around it in dental colleges.'' Following the impulse of his convictions, he founded the Angle School of Orthodontia. This school was established in 1900, just twenty-five (now thirty-six) years ago. This would be an appropriate time to celebrate the silver (now some other sort) anniversary. With this act, the foundation of orthodontia as a specialty was laid. But, in order to fulfill the other requirements for an independent profession, Angle also realized the necessity for an organization where, by proper intercourse and interchange of ideas between individuals with mutual interests, the knowledge of orthodontia could be still further promoted. He, therefore, in 1901, was instrumental in organizing the American Society of Orthodontists.

A further step forward was taken when, in 1905, the Alumni Society of the Angle School of Orthodontia was organized. With this step, a group of like-minded individuals was brought into closer contact. A sympathetic relationship between persons imbued with the same spirit of progress, with like ideas and ideals was thus assured.

This, however, did not complete Angle's insatiable desire to further the interests of his specialty. There was another factor necessary to complete the requirements of a fully established profession. A medium for recording and publishing the transactions, activities, and attainments of such an organization was indispensable. An independent journal ''for the promotion of orthodontia as a specialty'' was established in 1907. Thus, with an independent school, an alumni society, and a journal to promulgate Angle's ideas, to implant his principles, and to disseminate his ideals, a specialty was founded that instantly won general approbation and world-wide recognition.

With these achievements, Angle won the meritorious distinction of assuming a position as the father of our specialty. Thus, within the span of less than a decade, Angle not only laid the foundation for a specialty which at once rose to significant prominence, but also by his high ideals he established a tradition. This tradition was synonymous with the highest principles and best achievement in orthodontia, and commanded respect, admiration, and reverence not only of his students, but also of the entire profession. It was this Angle tradition that furnished the impetus for greatest orthodontic advancement and lifted orthodontia from the ranks of craftsmanship to the status of a profession.

Jealousy and envy soon crept in, and much antagonism arose with the attempt to undermine all that was accomplished. But, as long as the Angle tradition prevailed and served as the standard bearer of an intrepid and enterprising group of pioneers in orthodontia, it was well able to resist the impact of derogatory influences. In recent years, a very significant change has been noticeably taking place. Whether there is a general let-down in our loyalty to it or whether the tradition itself is gradually fading out is not quite clear. Certain it is that orthodontia is drifting back into the regions where Angle first found it. What is the trouble and what is the cause of it? Has the tradition outlived its usefulness or have we failed to uphold it? To put it differently, is the Angle tradition decadent because of external influences, or is it tottering because of internal discord and dissension?

If the events following the spectacular rise of orthodontia be traced for just a few years, some outstanding incidents appear which seem to furnish the key to the trouble. In doing that, one is surprised by an incongruity which fails to square with the deeds. It appears that no sooner had Angle completed his own structure than he began to undermine its foundation by tugging at its most vulnerable points. The original Angle School was the first to cave in. The reason for it is not so difficult to understand for anyone with some experience in practical affairs. The act of establishing an educational institution carries with it no more guarantee for the future than does the act of undertaking a business enterprise. The future depends in a large measure on the foundation upon which it is built and the provisions made for the subsequent carrying on of the business of education on an independent, profitable, and equitable basis. Were such conditions provided for by Angle in his undertakings? The answers to these questions will become evident when the subsequent incidents will be recited.

In 1911, at New London, Connecticut, and under the most auspicious circumstances, the Angle School held its last session under the original regime. The principles, ideas, and ideals upon which it was founded prevailed perhaps more in this course than in all previous ones. Everything was proceeding with great promise and much enthusiasm. No one realized that the end was near. But this became a fact, as the old established school never convened again under the same auspices.

In the same year, 1911, when the *American Orthodontist* just began to get on its feet, the publication ceased. Those who came more closely in touch with the circumstances under which this journal was issued will testify to the difficulties, hardships, and personal sacrifices entailed in carrying on its publication for the four years of its existence. The devotion to the cause of those entrusted with the burden never lagged. The cessation of this publication was, therefore, not due to any slackening in the ardor of the task, nor to lack of funds. Everyone was glad to share the responsibility. No attempt, however, will now be made to point out the cause of the demise of the *American Orthodontist*. The actual fact is the only thing to be considered for the present.

Two years later, 1913, also witnessed the last meeting of the members in good standing of the Alumni Society of the Angle School of Orthodontia. No official notice of any subsequent meeting was received by the members at large after 1913. In so far as its total membership was concerned, the Alumni Society ceased to function as such in 1913.

Thus, in just thirteen years (I wonder if the number is significant), we witnessed a total collapse of the three chief agencies which served to build up orthodontia as an independent specialty.

Discouraging as these major events were, they were accompanied by minor occurrences that had a tendency to a total demoralization in the ranks of the most enthusiastic followers of Angle. For example, the introduction in 1911 of a radically new departure in the method of orthodontic procedure brought about a great deal of confusion—not to mention the mental anguish suffered by many. No one can deny the fact that the introduction of any radical change

must be expected to meet with some opposition or certain indifference. Human beings are not all constituted alike. Some vary in intelligence, some in understanding, some in skill, some in reaction, and so on. If due allowance is made for such differences, it will be quite obvious how preposterous it is to expect an unqualified acceptance of any measure that may have an adverse effect upon one's life or occupation. Those having to their credit previous experience, previous skill, and previous achievements are naturally cautious and reluctant to accept radical changes. As a result, there is to be expected an inevitable division of opinions, purposes, efforts, attainments, and convictions. It should also be remembered that man is not only a physical and an intellectual being; he is also an emotional being. Moreover, the emotions in our civilized life come in for a large share in the never-ending struggles of everyday experience. As a result, when a new measure is introduced affecting certain life habits, there is to be expected a separation of those who adopt it from those who reject it.

This is just what happened when the "pin and tube" appliance was introduced as a new and revolutionizing method in orthodontic procedure. Those who developed a high degree of skill, those who acquired a high degree of knowledge, those who possessed superior proficiency and ability in the manipulation of the "old" appliance were not ready to give it up, especially when they were able to show creditable achievements with it. Thus, a split was brought about between those who stuck to the "old" method and those who adopted the "new" method. The subsequent introduction of the "ribbon arch" appliance aggravated the situation. There was then a threefold grouping. One group was composed of those who stuck to the "old" appliance, one group of those who adopted the "new" method, and one group of those who were ultrafashionable and took to the "newer" device. The fourth group, comprising the edgewise arch enthusiasts, is the last and newest addition to this classification.

There is another human tendency contributing toward diversification: the tendency, for instance, of modifying things, methods, or practices with the purpose of adapting them to individual needs, to individual ability, to individual skill, and to individual expediency. No method, however superior, will indiscriminately suit all alike who employ it, and no method, however efficient, will meet all conditions and all needs in the same way. Mature judgment has to be exercised in all instances. In other words, adaptations and modifications have to be made in a large number of instances to meet the needs in a practical, sensible, as well as efficacious way. This depends upon sound judgment matured by experience. How is judgment to mature when what is to be judged is constantly changing and experience with it is inevitably at the beginning?

Orthodontic appliances and methods of handling them constitute no exception to this tendency. Given an appliance of the best sort, it will be manipulated differently by different individuals. One may choose to make a slight change in one respect, another in another respect. The range of modification of an orthodontic appliance is not difficult to imagine. The question is: "Does variation in technique interfere with unanimity in purpose?" Does it really matter whether certain changes are made in the originally devised mechanism, as long as the fundamental principles involved in treatment are steadfastly

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observed and the objective aims conscientiously carried out? It would seem that among orthodontists this question is one of the chief bones of contention, causing more misunderstanding than any other points at issue.

Orthodontia has always been on the war-path on account of differences in appliances. As long as the battles raged between the camps that stood for differences in principles as well as methods, the situation was tolerable. But, since invasions of hostility are beginning to appear in the same camp, the situation is assuming a more serious aspect. That this is no imaginary assumption is borne out by many instances in the experience of every one present. The insistence of those practicing the "new" method to cast reflections upon those still employing the "old" method, and the insinuations of those who recently acquired the "newer" method against the efforts of all the others is, to say the least, pernicious, unwarranted, and wholly uncalled for. It is, for instance, not uncommon to hear such statements as: "Those who have not adopted the ribbon arch appliances are ten years behind the times." I wonder how such statements sound now to those who made them then. Does it really matter what appliance is employed, as long as it is employed in good faith and creditable results can be produced? In the course of my experience, I have seen some pretty poor results with the best appliance and some excellent results with the poorest appliance. Is it really so much a matter of appliance or method, or is it a matter of principle and aim that modern orthodontia stands for?

Is it really necessary that, in order to gain popular favor, one must follow the latest dictates in style to produce creditable results? As I can see it, orthodontic procedure is not a commodity changeable by the decree of fashion. Orthodontia is a profession and, in order to practice it conscientiously and honestly, it must be pursued without prejudice or preconception of any kind of procedure, provided it is backed by knowledge, skill, ability, and guided by mature judgment. Of course, it is not very likely now that there might occur another rift on account of another new appliance. We already have more appliances than we know what to do with. The question then arises: "Are those old rifts so irreparable as to obscure the larger aspect of orthodontia's progress?" I am of the opinion that orthodontia has had its rise and its fall. Both were apparently brought about by the same force. From general observation one may be led to the assumption that the ideals with which we started out have suffered a severe jolt and that the principles and aims we headed for are now flat on their backs. Are we to let petty obstacles which separated us in the past interfere with cooperating in a joint enterprise as a safeguard for the future?

*[Is it necessary and conducive to professional dignity for an orthodontist to convey the impression to prospective patients that the type of appliance to be employed in treatment carries with it a guarantee of success? That such practices are resorted to is forcefully and frequently brought to the attention of most of us, when prospective patients who were "shopping" in other offices

*The part within these brackets was read in the original paper as presented in 1925, but omitted in the paper of 1936. It is included here because these observations are so fundamental. —*Editors.*

ask such questions as: "Doctor, are you using this kind or that kind of appliance?" This situation betrays an attitude that some orthodontists are still laboring under the delusion that they are selling appliances instead of waking up to the fact that they are rendering services.

That this is no mere assumption was forcefully brought to my attention recently (1925). The father of a patient, who only a few days ago came to me to negotiate the matter of fee, distinctly told me that another orthodontist was willing to undertake the treatment if he would be paid a certain stated sum for the appliances and so much per month for treatment. In this respect, we have a great deal to learn from the practices of the modern progressive dentist. Not so long ago, it was customary for the dentist to gauge his fee by the kind of material used for fillings, bridges, or plates. Now he is remunerated for the time consumed in rendering the necessary service. The orthodontist, too, ought to impress his patients with the fact that his fee is measured by the quality of service he renders, and the time consumed in rendering it—not by the kind and number of appliances he employs.

If there is any grievance against the use of an appliance, the society meetings are the logical places for thrashing out the matter. The public is not interested and should not be entrusted with such matters, because they lack the necessary knowledge and are really not concerned about it. What the public wants and pays for and what it considers important are the results in terms of efficient service that they are to get in return for their money. Whether the best possible results are obtainable by this or that kind of appliance can as yet be determined by none of us with any degree of accuracy. Why then confuse the people with details that the profession itself is not unanimous about? Besides this, does not such practice tend to deepen the cleft already apparent among many of us striving to do our best?

True enough, each of us deviates in some way or other from certain established customs of practice. Some find that physical exercise promotes orthodontic treatment, others are convinced that engineering is essential for successful results, while many of us believe an advantage has been discovered in modifications one way or another from the originally prescribed procedure. To create noticeable differences when finally compared with others, all of us strive to achieve the best possible results. Do such practices furnish sufficient ground for animosities of any kind?

Each of us has at one time or another obtained ideal results. They may have been limited in scope and in number. We all have had failures, too. It is quite safe to say that there is no one present here who can boast of 100 per cent success and no failures at all. I say this not unmindful of the fact that some appliances or procedures are acclaimed as infallible. Nevertheless, I have my doubts about them. We, consequently, have both successes and failures to our credit. Can we give an adequate account for either? If we could, it would be possible to eliminate failure and choose success. But we cannot, because failures are due to lack of knowledge—if indeed not to ignorance.

We are all more or less ignorant to some extent. At best, we are not omniscient. For example, we have learned to repeat parrot fashion certain

phrases and, due to the many repetitions, some have come to believe in them. All they think necessary to explain a situation is to call it by a name and the thing is done. Take, for instance, the phrase "physiological tooth movement." This is a perfectly good phrase and I have no grievance against it. But what do we really mean by applying it in connection with mechanical devices? Do we know so much physiology as to be able to determine when a mechanical procedure is physiological or not? Do we know so much about tooth movement as to be able to know with accuracy when it is physiological or when not? An adequate definition of "physiological tooth movement" is still wanting.

Another perfectly good phrase is "mechanical stimulus." Do we have other stimuli that may be used in orthodontia? If so, what are they, how do they differ, and why should the "mechanical stimulus" be given the preference? What do we know about stimuli anyway? Are we able to distinguish between different degrees in the effect of stimuli? Do we know how the effect of minimum stimulation differs from the effect of maximum stimulation? Can we determine which point in the range between the minimum and the maximum would bring about optimum responses? Do we know anything of the effect of *summation*—I mean the cumulative effect of a continued but mild form of stimulation?

"Bone growth" is another favorite phrase used by orthodontists. The constant reference to this phrase would lead one to the assumption that the orthodontist is able to grow bones as the gardener grows cabbages or potatoes. But, in reality, do we actually grasp the fundamental idea entailed in the process of growth? Do we really make bone grow? Growth is one of the fundamental phenomena of life and occurs as long as life lasts. In fact, the question may be asked: "Can growth be stopped while life persists?" It may in some instances be partly inhibited or temporarily suppressed, but not entirely stopped. In another way it may be stimulated or increased. An accidental bruise or a cut in the skin may start the skin growing. A fracture will start the bone to grow. This happens through an inherent property of tissue repair with which most living tissues are endowed.

But does an orthodontic appliance produce changes in form and increase in size of the alveolar process? It surely does, but it does not *make* it grow. The property of growth is present. The orthodontic appliance simply exerts an influence upon the direction of growth. How, is not known. It is assumed that the appliance just causes a sort of injury to the bone tissue and, due to the property of tissue repair, the bone regenerates. This, however, will happen only when the injury is not too great. Moreover, when we think of the different textures of bone, we may well be mindful of the character of the bone thus "grown." It is well known that cicatricial tissue—the repair tissue produced after an injury—is of a different texture than the original tissue. Of what texture is the bone regenerated after orthodontic treatment?

Another familiar phrase commonly employed is "tooth material." What is meant by this term is the number of teeth included in a measurement taken between two points in one of the dental arches. Now just think. A string or its equivalent is used for this measurement, and its length is imagined to represent a quantity, the quantity of tooth material. If "tooth material" means

anything, it means the "stuff" that the teeth are made of. The "stuff" that the teeth are made of comes in the form of teeth and in no other form. A tooth is a structure having a cubical displacement in space. How can we designate a cube, which is a combination of measurements in three dimensions of space, by a measurement in one direction—that is, by a linear dimension? Just think of the ignorance under which we are laboring. Do we realize how much there is to be known in contrast to the little that is known?

In the case of appliances, similar commonplace errors are committed. Admitting for the sake of argument that a certain appliance is the best appliance, what is the criterion by which its superiority is determined? Some claim that the rapidity with which it does its work is the determining factor. The question then arises, "What is the determining factor to prove that *rapid* tooth movement is the *best* tooth movement?"

Did it ever occur to you that in all orthodontic procedure no attempt is known to have been made for measuring the actual amount of energy (force) that an appliance is able to deliver? Nor do we know of an attempt to determine the amount of force needed to move a tooth. In physics, we speak of the calory as one of two recognized heat units. The greater calory is the amount of heat necessary to raise one kilogram of water one degree centigrade; the lesser calory is the amount of heat necessary to raise one gram of water one degree centigrade. Were it possible to establish such a unit of force, we would then have a standard to indicate how much energy would be needed to move a tooth. Furthermore, if such a measure were available, it would then be necessary to determine how long a time it would take to move a tooth a certain distance. This would be good physics. Can we talk physics of this sort as applied to orthodontia? We talk of mechanical stimuli, of physiological tooth movement, of bone growth, and many other such matters. However, who can tell exactly how much force is delivered by an appliance—the best appliance—and how much of it is needed to move a tooth any distance? Moreover, who can tell whether the same amount of force would suffice to move every tooth in the same mouth, the like tooth in different mouths, or in the same mouth at different ages? These are the sorts of questions arising in my mind when discussing the topic of mechanical appliances.

In my estimation, there is as yet no such thing as pure physics or pure mechanics in orthodontia. The experiences of everyone will attest to the fact that under favorable biologic conditions the worst possible mechanics may yield a good result, while under unfavorable biologic conditions the best mechanical device will yield no result. The problem we are really confronted with is to be able to distinguish between favorable and unfavorable biologic conditions. This we are as yet unable to do—hence, the failures we are all acquainted with.

The ability of recognizing biologic phenomena will enable one to enhance certain physical shortcomings. Stilts, for example, attached to the legs will increase their length and help attain a greater stride. But, when the legs are paralyzed, crutches will be of greater advantage. But in this case, the arms and hands must be able to hold them. We would, however, not advise the use of crutches when the arms are paralyzed. This would seem a far-fetched

example, but it is not. I have seen orthodontic appliances similarly handled. Instead of a perfectly good appliance being adjusted on the dental arch requiring it, it was on the opposite one. Do you know why? Because the individual who adjusted it did not really know just what the fundamental condition of malocclusion of the teeth is. In many instances, you will find that not the condition but rather the symptoms are being treated because it is not definitely known just what the trouble is, where it is located, and how it came about. We have as yet to establish a comprehensive knowledge of the anatomy, the physiology, and the pathology of malocclusion.

The reason for this may be found in our education. Our education is just a succession of acquisitions of different kinds of tricks. Just like the acrobats, we have learned to turn different sorts of somersaults and, because we can do them successfully a number of times and because of the nature of the trick, we imagine that we can defy gravity. But, sooner or later, we slip or miscalculate the distance or our muscles fail to respond quickly enough, and we are painfully reminded that the law of gravity is inexorable. We realize then that something is wrong, and attribute it either to the lack of knowing the latest trick or to a lack of possessing some new equipment. We then quickly get busy and learn another trick or we add more to our equipment. But, after all is said and done, there is nothing new acquired. We have just learned that the same tooth movement can be accomplished in a different way and that we have burdened ourselves with the care and accommodation of more fixtures.

On account of this tendency, the orthodontist is an easy prey for all kinds of contraptions. Let us consider a few instances. A few years ago, a plan was placed before the orthodontists and the necessary machinery for it was put on the market. By this plan, it was claimed that no case of malocclusion of the teeth can be treated before it is thoroughly "surveyed" by a competent and skilled engineer. Orthodontic surveying soon became quite fashionable. Almost every orthodontist became an engineer. It was really becoming so serious at one time as to give rise to the idea that to become a successful orthodontist one must take a course in engineering. Time, however, proved that this was not so. The engineers employed in this scheme have gone back to engineering, and the orthodontists who adopted it, though still surveying, contributed nothing to the advancement of orthodontia. You cannot become an engineer by knowing a few orthodontic tricks, and you cannot become an orthodontist by knowing a few engineering tricks.

Recently, this has been superseded by another scheme—a so-called scientific method for the improvement of orthodontic diagnosis and orthodontic technique. This is a new and more subtle idea and will perhaps take longer to look through. But judging from general observation, it has taken root and is growing rapidly. The effects are already manifest by an unwarranted tendency to extract teeth in the treatment of malocclusion. Many offices are now being equipped with the most elaborate apparatus for anthropometric procedures. This is done to give a scientific flavor to a pernicious practice. Every progressive orthodontist is thus being suddenly metamorphosed into an anthropologist. Is the orthodontist really under the impression that instruments made the

anthropologists? Some day he will discover that anthropologists made the instruments. Moreover, he will also discover the fact that instruments, in so far at least as anthropology is concerned, are a means to an end and not the end. He may also discover that what orthodontia needs most is not technique, but skill and knowledge; not methods, but fundamental principles. We already have more technique and more methods than we know how to use.

A great lawyer, statesman, and philosopher, Francis Bacon, said that truth came out of error much more rapidly than it came out of confusion. Thomas H. Huxley maintained that "next to being right in this world, the best of all things is to be clearly and definitely wrong, because you will come out somewhere. If you go on buzzing about between right and wrong, vibrating and fluctuating, you come out nowhere; but if you are absolutely and thoroughly and persistently wrong, you must, some of these days, have the extreme good fortune of knocking your head against a fact, and that sets you all straight again."

The trouble is that in the training of orthodontists the knowledge necessary for the recognition of facts is lacking. The result is that even when brought face to face with actual facts we fail to see them. We are more prone to accept what came down to us by tradition than to learn what actual facts will teach us. The effect of traditional teaching and actual experience confuses us.]

When I last read this paper, I had a remedy. I shall impose upon your good nature to read it again. But you must transpose yourselves back eleven years to get the idea. I proposed then what I thought was needed then.

THE REMEDY

It must be realized that among all professions in the healing art of today, orthodontia stands alone in that it has no generally recognized educational institution for fitting young men or women to practice it.* Among all professions in the healing art of today, orthodontia stands alone in that it has no clinic to afford the opportunity for recent graduates to acquire even a moderate amount of skill and experience in the treatment of malocclusion of the teeth before entering actual practice.† The beginners in orthodontia today are confronted with a situation considerably worse than those of twenty-five (now thirty-six) years ago, because of the greater demands of the time and because of the inadequate way of meeting them.

Orthodontia received its greatest impetus by the establishment of a school, by the foundation of a journal, and by the organization of a society. There are at present two schools—the Angle College and the Dewey School—the policy of neither of which is quite well defined or generally known. Of course, since this was written, the Angle College has again ceased to exist, no doubt due to a repetition of the mistakes made before. Of the Dewey School nothing is heard now (1936). The JOURNAL, which is supposed to publish all matters pertaining

*Since this was written, several dental schools have organized departments for graduate instruction in orthodontia.

†In the eleven years just past, there has been an overproduction of clinics. We now find clinics not only in dental schools, but also in hospitals. Besides this, there are also some private clinics. Those who are acquainted with the working of these institutions will testify to the confusion prevailing now.

to orthodontia, is hitched up with radiography and oral surgery, and now with children's dentistry.* The *Angle Orthodontist* is now taking the place of the *American Orthodontist*. The Society accordingly is the only establishment founded on a cooperative basis and on democratic principles. But the Society alone is unable to cope with the situation as it presents itself today. The object of this Association is according to its constitution: "The study of Orthodontia, its advancement and the promulgation of the welfare of the Angle School and its Alumni Society."

It may well be asked how far this Association has succeeded in attaining its object. On the face of it, it would seem that under the changed conditions this Association can only live up to the first part of its object, because the last part has become obsolete and purposeless. Its existence can therefore be devoted only to "The study of Orthodontia and its advancement." Nothing can be gainsaid about the study of orthodontia, because it is my belief that everyone is unconsciously and unintentionally studying it by the sheer fact of practicing it.

But how much has orthodontia as a united profession been advanced since the organization of this Association? The contributions made annually in the form of papers, though very significant for scientific advancement, are not sufficient for the purpose of advancing a profession. Something more than that must be accomplished to place orthodontia on a higher plane than where we found it.

Eleven years ago, I was convinced that then was the psychological moment to do something if we would attain our purpose. The dental schools throughout the country were then being absorbed by universities. The universities were aiming to establish dental education on a higher plane and on a more sound foundation. Orthodontia was coming in for a large share in such consideration.

I was of the belief that we must recognize the fact that there is a higher aim in orthodontic organization than playing political games. The future of orthodontia and how best to equip the coming orthodontists should be the goal. We must show a more active and sympathetic interest in the dental educational movement.

But, before any attempt was made, I thought it necessary to reach a unanimous understanding relative to the greatest needs of orthodontia at that time. For such purpose, it is first necessary to take an inventory of all that is comprised in the concept of orthodontia in the modern sense of the word, of what it has achieved, of what it is to achieve, and wherein it has failed. A program may then be formulated with the purpose in view of improving the methods of education, suggesting the inclusion in the curricula of such subjects as would supply the necessary fundamental information we are so woefully lacking.

For such a purpose, we must be prepared to report our experiences in the light of our achievements and our failures. I felt then that most of us were on

*With the January, 1948, issue, the JOURNAL is now devoted exclusively to orthodontia. —*Editors.*

the declining grade of our professional career. We must look forward so that the coming generation will be better equipped and not have to go through the same hardships as we had to in the building up of our specialty. This will help not only to infuse new enthusiasm in the older practitioners, but will also help to furnish an adequate source from which orthodontia will fill its ranks with men fully able to make it the standard bearer among the specialties in dentistry of the future as it has been in the past.

I was fully convinced then that the task is not easy, but that it is also not impossible. Therefore, I cautioned that we must approach this problem in a sensible and practical way. The reorganization of our educational institutions entails immense financial obligations. Besides offering suggestions for the perfection of orthodontic education, we must be ready to cooperate in helping to furnish the funds necessary to carry out such a project successfully. My idea was that a thorough investigation should be instituted to include all universities that have given serious thought to orthodontic education. The best equipped, most sympathetic to our ideas, and most conveniently located institution should be chosen. We may still have a chance to establish an independent educational school or institution for the teaching and promotion of orthodontia.

The following recommendations made eleven years ago may still be of help:

> First, we should be willing and agree to cooperate in the establishment of a fund for the endowment of a professorship of orthodontia at a university. From this chair shall be taught that branch of knowledge of which we are in greatest need.
>
> Second, we should be willing to cooperate in the establishment of a fund for the endowment of at least one free scholarship in orthodontia.
>
> Third, we should be willing to work for the establishment of a fund for the endowment of a yearly prize to be awarded for the best work done by the orthodontic student in his postgraduate studies.

Another step in furthering the advancement of orthodontia is to stimulate scientific and clinical research. For this purpose, it is necessary to keep in touch with the latest discoveries and the latest achievements not only in theoretical and clinical orthodontia, but also in general science. It would be of immense value to establish a yearly course of lectures by competent men on subjects having a direct bearing on the problems of orthodontia or on its related sciences, such as biology, anthropology, art, evolution, and perhaps physics too. Such a series of lectures should then be published by the Association under the auspices of an established fund. A prize may occasionally be offered for an original contribution on a certain topic of interest to orthodontia. A museum and library too should not be left out of the picture of the future.

Granted that this is an ambitious program, nevertheless, it is not unattainable. Unless a strong effort is made to reach some such goal, we might as well despair of the confusion afflicting the orthodontist today and of its effect on the orthodontist of the future.

The step ahead of us then is to forget the petty differences of the past, remember the broader aspects of the future, and get together and do something about it.

[In 1943, Dr. Hellman felt that, because of the rapid change in orthodontic thought, attention should be called to what was transpiring. He, therefore, prepared "At the Crossroads" and "Fundamental Principles . . ." which follow.—*Editors.*]

At the Crossroads*

[Just now orthodontia finds itself at the crossroads. It is not entirely new, but very regrettable. The reason for it is disturbing, but not avoidable.] The specialty of orthodontia has been harassed from the very beginning by the specter of variety in technical issues. Methods of procedure in orthodontic practice, like those in other disciplines serving human needs, have, all too often, been sources of disturbing consequences. Customary contentions in extolling one and deprecating another inadvertently end in controversies which undermine confidence, cause confusion, and impede progress.

Spectacular results in orthodontic practice are very impressive and greatly admired, but essentially they signify nothing beyond demonstrating the potentiality of orthodontic achievement. The trouble is that failures, too [though ignored], cannot be denied. Reliability in achievement, therefore, depends upon proof that the proportion of successes is greater than that of failures. This is still lacking. To ascertain the relationship between them requires long stretches in time. Orthodontia is now old enough to furnish such evidence. But so far it has not done it. Being engaged now in an analysis of this problem, I am amazed by the complexity of its ramifications.

[What stands out clearly is that there is no unanimity in anything orthodontic. There is no clear-cut mutual understanding of what is important, fundamental, and significant as there is none of what is immaterial, relative, and unessential. As a consequence, all arguments are concerned with minor details in treatment of cases and desultory results attributed to faulty techniques. What constitutes success or failure is as little understood as the fundamental principles upon which technical principles rest. In the estimation of many, the crowding of lower incisor teeth, though occurring many years after a successful result in treatment, is considered as much of a failure as the dire result following incompetence and bungling. Resorting to extraction (the extraction of four teeth is now recommended) under such conditions may be a convenient way of covering over incompetence, but it does not justify mutilation of a complete dentition.]

The rationalization now rampant and used as a yardstick is that *the end justifies the means.* But what is completely overlooked is the important demand that the end sought should conform to basic concepts in orthodontic aims, and that the means used should comply with fundamental principles in orthodontic practices. Progress is not made by preferences and expedients which violate both.

The most significant advance of the specialty of orthodontia occurred in the decade following the establishment by Angle of the first school for the special training of orthodontists. The reason is that, before establishing the

*Signed editorial reprinted from American Journal of Orthodontics and Oral Surgery, St. Louis. Vol. 29, No. 10, Orthodontics Pages 610-613, October, 1943. (Printed in the U. S. A.) Except for sentences enclosed in brackets, this editorial is reprinted without change. The additions were written by the author shortly before his death.—*Editors.*

school, Angle had built a foundation of principles, based on scientific truths and practical experiences. The effect of it was to instill a thorough understanding of the orthodontic concept and to furnish a guide for the use of mechanical devices. The basic principles were not invented. They were derived from proved facts prevailing in nature. Those selected were of special significance in basic sciences. Teeth, their arrangement and relationship, are general biologic realities. Their physiological significance is closely related to preservation of life in general, continuation of existence among groups, and maintenance of health among individuals. The testimony from phylogeny, comparative anatomy, and ontogeny bears abundant proof of the importance of such basic concepts. The human dentition is no exception to the general rule. Angle was fully justified in considering as basic: (1) the inviolate dental formula of the human dentition, (2) the form of the human dental arches when the dental formula consists of the full complement of teeth, and (3) the occlusion of the teeth when conditions (1) and (2) are normal. Angle thus regarded the dentition in normal occlusion as the standard by which to appraise dentitions which did not conform to it. Any deviation from the standard of the normal was considered abnormal. Since the normal had reference to occlusion, the abnormal was designated as malocclusion.

Of course "uneven," "irregular," or "crooked" teeth had been known before, and attempts to "straighten" them were made in the dim history of the past. But there was no orderly or systematic way for appraising the great variety of dentitions which deviated from the normal standard as it was envisaged by Angle. Angle happened to notice that, though dentitions deviated in occlusion in many ways from the normal standard, there were some in which certain peculiarities were much alike. By taking into account the resemblances and the differences among them, he was able to sort out all "irregularities" into three groups or classes of malocclusion, each having like peculiarities which were different from the other two. Thus, by recognizing the natural condition as the normal and using it as a standard in occlusion, and by establishing a systematic classification of malocclusion, Angle laid the foundation for a sound basic concept in orthodontia. What Angle failed to do was to point out the fact of normal variation. Though he mentioned it, he did not clarify its significance. The purpose of establishing this basic concept, however, was to use the dentition in normal occlusion as the goal when contemplating the correction of dentitions in malocclusion.

The means to do it with were similarly devised to correspond with a set of basic principles. The qualifications of an adequate appliance were to be determined by four basic requirements. It had to be efficient, simple, delicate, and inconspicuous. The appliance originally devised by Angle, accordingly, *fully met these requirements.*

There was, however, one more thing which bothered Angle. The prevailing methods of that time for "straightening crooked teeth" was to extract some and "straighten" the others. Angle recognized the harm done to the patients and resented it. To make it clear and emphatic he expressed his views and convictions in the form of a "law," as follows: "The best balance, the best har-

mony, the best proportions of the mouth in its relations to the other features require that there shall be *the full complement of teeth, and that each tooth shall be made to occupy its normal position—normal occlusion.*" This "law" was obviously intended to indicate that extraction of teeth for orthodontic purposes was not only needless, but also detrimental to the achievement of best results.

The students and followers of Angle were impressed by the soundness of this setup and the significance of his convictions. They pledged their allegiance and support and, with the zeal and devotion of pioneers, made rapid headway in bringing the specialty of orthodontia to the fore. The success was phenomenal and orthodontia quickly won world-wide recognition. The principles in concept and methods of technique became a tradition. The unanimous understanding of and faithful adherence to it forged the way ahead.

Though considerably subdued, the practice of extracting teeth for orthodontic purposes really never entirely ceased. As previously regarded, it was a vestige of antiquated procedure or an expedient for compromised treatment. Those resorting to it were considered as either opposed to progressive methods or as failing to understand the basic orthodontic concept. Often, the practice of extracting teeth would burst forth to disturbing proportions, but after some harmful consequences were encountered, it would subside again to previous levels. Lately, it has flared up again with considerable vigor, and judging from the enthusiasm with which it is being spread, the indication is for a long endurance. Unlike previous recurrences, the current surge is swelled by those who were among the most faithful and devoted followers of the Angle tradition. The significance of a situation of this sort is of concern to some and confusing to others. Since extracting teeth is a contradiction to the basic concept of normal occlusion, the question is, which is wrong? There are many orthodontists who are puzzled and confused by this question because no clear-cut answer has as yet come forth. They are wondering whether the basic concept of orthodontic aims has been renounced and whether the fundamental principles in method of procedure have been discarded. The obvious inference, which cannot be avoided, is that an attempt is now being made to substitute an old notion in the form of a "philosophy" for those principles in orthodontia which were the seeds of its development. The pretext is "bimaxillary protrusion," and the justification, an efficient method of procedure to correct it.

There has always been a secret desire among many practitioners to push teeth back. Whenever a mechanical device looked favorable, the attempt was made to do it. The trouble was that pushing all the teeth back was too much of a task, so a compromise was always inevitable. By extracting some it seemed easier to push the others back. "Bimaxillary protrusion" furnished the incentive. It is an ideal (?) condition for testing a promising procedure. The new technique and accompanying "philosophy" now being advanced appear to be eminently fitted for the purpose. Judging from the widespread acclaim, it apparently seems to achieve the objective.

What "bimaxillary protrusion" really is and how it is determined is not very clear. C. S. Case refers to it as "dentofacial maloclusion" but correctly

admits that "most of them have typically normal occlusion." The incidence of its occurrence among orthodontic patients is really not known; but prevailing orthodontic practice is now busily engaged in transposing dentitions backward "by leaving the anterior teeth in linguoaxial inclination and the buccal teeth in distoaxial inclination." That it is done at the cost of teeth and occlusion is obviously of no consequence. The result aimed at is apparently worth the sacrifice. The claim is that it is successfully achieved. If so, by what standard is such success appraised? Is it "personal equation" which determines success? Results already demonstrated indicate that there are some features entailed which should be taken into account in the appraisal of success. Extraction of teeth, for instance, which, and how many? Disturbing the normal position of teeth or "repositioning" them, to what extent? Unavoidable tissue destruction, how much of it is safe? Disregarding "cuspal relationships," then what is the difference between malocclusion and the finished product? And why bother?

There are also questions which might be asked by those whose concern about the status of the profession is of as great importance as that about procedures in treating cases. By embracing the new "philosophy" one may ask:

1. What is to become of the foundation of those principles upon which the specialty of orthodontia was built up? (a) What significance may now be attached to normal occlusion as it is found in nature if it is to be ignored in treatment? (b) Of what significance is the Angle classification of malocclusion if "all malocclusions may be considered as complicated by forward positioning of the teeth in relation to their basal bone?" [In fact, what is occlusion, and malocclusion?]

2. What is meant by "bimaxillary protrusion" or "forward positioning of the teeth?" How is it ascertained, and into what is it transformed after treatment, if normal occlusion is not the goal?

3. What position is orthodontia to assume in its present setting if, as is apparent, the basic concept is ignored? Is it to continue as an independent specialty the way Angle started it, or is it to be practiced as an auxiliary to, in collaboration with, or in imitation of, exodontia, prosthodontia, or oral surgery?

Frankly, the specialty of orthodontia is now at the crossroads. The direction to follow is confusing to many. Though questions might help to stir up thinking, it is certain that answers alone do not decide critical issues. The destiny of orthodontia lies in the realm of fundamental education. The hope is that scientific knowledge, straight thinking, sound judgment, common interest, organized effort, and reliable leadership will, eventually, reaffirm the basic concept upon which orthodontia was founded and still stands.

Milo Hellman.

Fundamental Principles and Expedient Compromises in Orthodontic Procedures*

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PRINCIPLES and compromises used as comparative standards indicate opposite trends in mental attitudes. Principles thus have reference to tenets or doctrines, basic and permanent; and compromises, to settlement of controversies by surrendering principles. Fundamentals and expedients are just barriers limiting the trends to narrower confinements. Accordingly, "fundamental principles and expedient compromises in orthodontic procedure" may suggest an attempt to deal with moral issues. This, of course, is what I am not going to do. The reason I am mentioning these things is because there is so much philosophic dust raised about orthodontic aims and technical procedures as to obscure the nature of the goal and blur the source of its origin.

Just now, I am interested more in the destiny of orthodontia than in the moral trends or technical creeds of orthodontists. Despite the fact that the unsteady stream of life today makes the course of tomorrow so unpredictable, I believe that orthodontic practice and ethical standards must always be complementary. Similarly, I hold that basic concept and objective aim must be complementary too, despite the disturbing effect of the ever-increasing technical panaceas for the insufficiently known orthodontic evils.

The history of ebb and flow in conflicting ideas between "theory and practice" in orthodontia lends support to the belief that the more we seem to advance, the further back we go. This is probably due to the fact that appraisals of progress are often made by spurious standards. Extracting teeth for orthodontic purposes is a perennial example of it. Resorting to extractions inadvertently puts us back just where orthodontic history begins and contradicts the basic concept by compromising the aim. The "philosophies" used to fill in the vacuous gaps between concept and aim are, at best, just rampant rationalizations aimed at reconciling irreconcilable things. It may be that some of us have become "hard-boiled" by age and experience, but it cannot be denied that others have become softened up and insensible to "what's cookin'" by the long-continued pounding of sophistries upon the heads of those who are in the habit of sticking their necks out.

As a specialty in the department of health service, orthodontia, in my estimation, shares in common the foundation of science and art. Both in science and in art, existence, continuity, and progress would not be possible without systematic and orderly beginnings. *Fundamental principles* therefore are indispensable, because without them there can be no basic concept and no

*Reprinted from American Journal of Orthodontics and Oral Surgery, St. Louis, Vol. 30, No. 8, Orthodontics Pages 429-436, August, 1944. (Printed in the U. S. A.)

Read as part of the Extraction Panel at the meeting of the American Association of Orthodontists in Chicago, April 26, 1944.

objective aim. Principles, of course, must be sound and trustworthy to be of significance. They become of fundamental importance when derived from tested, proved, verified, and acknowledged facts which are basic in themselves. When recognized, approved, and endorsed, fundamental principles become the axis upon which the sphere of all related thinking and acting revolves.

In general, it should be understood that the axis of the orthodontic sphere is made up basically of teeth. It should, however, be remembered that orthodontia is concerned more intimately with multiplicity of teeth, with forms of teeth, with position of teeth, and with occlusion of teeth. This is fundamental because tooth number, form, position, and occlusion, in their application to the continuity of life on earth, are very significant features. According to the best available knowledge, they took part in such important biologic events as made the rise of many living creatures possible.[1] Even the coming of man is part of it.[2] Facts of this sort are important because they are fundamental. What makes them fundamental is the support gained from the unimpeachable evidence derived from such basic sciences as palaeontology, comparative anatomy, and embryology. Fundamental features of this kind are of significance to orthodontia because, in the evolution from the peglike denticles in the earliest vertebrates to the complex forms attained by the teeth in man, occlusion never ceased to be a concomitant factor.[3] These facts are also of special significance in orthodontia as they shed light on such differences in dentition as distinguish many groups among mammals and various races in man.[10] Thus, outstanding differences among mammals are found in (1) dental formula or number, (2) position of teeth, (3) their alignment into arch form, and (4) their adaptation to function. The changes which brought such differences about, whether they occurred simultaneously or in sequence, need not bother us now. The fact of significance is that they contributed substantially to the completion of the dentition of man as we know it today.[4]

Knowledge of this sort should be very impressive to orthodontists. It furnishes the most important biologic explanation of the responsibility for both the anatomical integrity of the dentition and the functional significance of occlusion. Consequently, the justification of orthodontia and the obligation of the orthodontist is to preserve the dentition and occlusion as they came to us from the dim past. We should at least be able to hold onto them for the present; if possible, for the future, too.

Edward H. Angle, who *made* the specialty of orthodontia, was not a scientist, but he had a remarkable scientific hunch. He had the good fortune to examine some skulls with exceptionally fine dentitions. He noticed that the teeth in those skulls were evenly aligned and well preserved. He also noticed that, on bringing the opposing jaws together, the teeth came into contact in what scientists used to call "mechanical relation of the upper and lower teeth."[5] The specimens in question being of adult human beings, he was careful to note that the number of teeth in each dentition was thirty-two. Angle was profoundly impressed by a dental equipment of that sort and decided to use it as a model for efficiency, superiority, or perfection. A dentition of this kind, he was convinced, would best serve as an ideal in orthodontic practice. It would furnish

the basic point to start from and the objective goal to aim at. To simplify the idea, he substituted the term "occlusion" for "mechanical relation" and used the word "normal" to indicate the superlative or ideal. Angle thus recognized, and wanted others to recognize too, that "normal occlusion" is of fundamental significance because it implies those requirements which are essential for functional efficiency. He was also convinced by previous experience that "normal occlusion" is attainable in all cases of malocclusion.

Angle was plagued then, just as some of us are now, by the all too frequent extractions of teeth for "regulating" purposes. Obviously abhorring this, he opposed it with all his might. In order to avoid misunderstanding, Angle first succeeded in proving that "normal occlusion" can be achieved *without* the extraction of teeth, and then formulated what he thought was a basic concept. The idea was to put orthodontia on a solid foundation and at the same time point out the fallacy of extractions. With his usual regard for system and order, he clad it with the authoritative mantle of "law." The "law," as he proclaims it, is that: "The best balance, the best harmony, the best proportions of the mouth in its relations to the other features require that there shall be *the full complement of teeth and that each tooth shall be made to occupy its normal position—normal occlusion.*"[6] Though the intention of this "law" was to put a taboo on the traditional evil of extraction, it was not very effective. But in framing it, Angle contributed to orthodontia a basic concept and a scientific aim, thereby issuing a challenge to orthodontists to solve a profound problem. This is the task which we are still grappling with.

The chief problem in orthodontia, as conceived and proposed by Angle and accepted by his followers who tried to solve it, is primarily concerned with: (1) the number and position of teeth and their occlusion; (2) the relationship of teeth to each other and their share in making up the form of the dental arches; (3) the effect of dental arch form upon the size and shape of the jawbones; and (4) the effect of the size and shape of the jawbones upon the aesthetic appearance of the face.

For the purpose of solving the problem in orthodontia, Angle first sorted out the varieties of occlusion as found in dentitions deviating from the "normal." He systematically separated them into three classes and devised appropriate technical means for gaining orthodontic ends in accordance with his basic concept of the problem as a whole. The guiding rules in practice were thus to be aimed at availability of proper equipment for services required in the restoration of "normal occlusion." To that end, the mechanical devices had to comply with exacting demands. They thus had to be "efficient," "simple," "delicate," and "inconspicuous." Progress from that point on was rapid and spectacular. Unfortunately, all of these rules in practice did not serve to guide us very long. Angle himself, by inventing the "pin and tube appliances" in 1911, retained just the first of his four technical demands and sacrificed the rest of them.

Like most of us, Angle, too, was a realist. He knew at the very outset that, to convince professional men, one is obliged to produce results. He did. He proved conclusively that, by the use of his original devices, it was possible to

comply with his basic concept and achieve the objectives aimed at. This was highly significant. It had hitherto been thought impossible to retain the full complement of teeth, restore all of them to their proper position, and establish normal occlusion. The success in achieving this aim is what *made* orthodontia a specialty and what made it possible for us to discuss today those things in orthodontia we are not so sure about.

The trouble was that Angle stopped a little short. While he proved to the satisfaction of everyone that what he believed possible he actually accomplished, he did not go beyond that. It was later on when those who followed him began to get into trouble. Though grasping fully the significance of normal occlusion and treating all forms of malocclusion successfully, there was some difficulty in holding on to the successes achieved. The occurrence of collapses after treatment was as unexpected as it was puzzling. Angle had not explained the possibility of it before. Besides mentioning that "retention" is for the purpose of "overcoming the tendency of the teeth to go back to previous positions," he did not explain the likelihood of failure or that of relapse. After the shock of my first experience, I casually asked Angle what became of the case shown in Figs. 501 to 508, on pages 494 to 498, of his book.[6] He said, "It went back." It was conciliatory, but not reassuring. The resemblance between this and my own case was too close for comfort.

As it strikes me now, the problem of "retention" itself was little understood then and I doubt whether it is better known today. At any rate, the technique of making sure of good results was inadequate and the consequence was that the result obtained never looked as well at the end of the "six months' retention period" as it did before the retaining devices were first put on. All felt guilty about it and blamed themselves for probable errors, faulty or careless technique, or insufficient skill. No one dared speak about orthodontic results in those days unless they were orthodontic successes. Retreating cases then was the usual order of the day.

It was not until 1935, at a meeting of the New York Society of Orthodontists, that orthodontic misadventures were openly and frankly discussed.[7] Since then, a great deal has been said and done, but, as it appears, not much has been learned. The concept of failures, unlike that of fundamental principles, was then, as it appears even today, obscure and confusing. Of course, my intention was *not* to discuss failures. But they just cannot be ignored. If it were not for failures, I am sure the topic for the panel discussion of today would not be on the agenda. But the particular reason I am mentioning failures is that people have such peculiar notions about them. For instance, according to, shall I say, the philosophy of Dr. Tweed, relapses (such as the crowding out from perfect alignment of one lower incisor tooth) constitute failures and the blame is invariably put on "bimaxillary protrusion." This, of course, may be a convenient way of explaining the need for compromises, but it really explains neither the condition nor the cause nor the cure. However, since "bimaxillary protrusion" is correctable by extracting teeth and since to omit extracting teeth means failure, then the compromise indicated is inevitable. By putting into

execution an attractive procedure with enough popular "appeal" to carry conviction, a panacea is at once available that will cure all orthodontic evils.

Now the meaning of what is talked about as "bimaxillary protrusion," in so far as I know, has not yet been explained. How it is determined is equally "a military secret." All that is known about it is either from the *a posteriori* inference that crowded lower incisors are due to "bimaxillary protrusion" or from the remedy prescribed for it. Namely, to correct "bimaxillary protrusion," it is held that the lower incisors are to mount to the top of the "ridge" over the "basal bone." Then all the other teeth are to retreat in order, according to plan. But, four teeth must be extracted first, and *I do not mean the third molars.* Judging from the general enthusiasm and fanatic zeal with which this is put into practice, the assumed assurance is that failures and relapses in orthodontia are banned for all time. If ever there was a *panacea*, here it is. Take it or leave it.

I wish to emphasize that I have no quarrel with Dr. Tweed. I even admire his courage when he ventures to demonstrate so much wisdom with the support of so little exact knowledge. What puzzles me is the vociferous approval by so many of a web of "philosophy," theory, or what have you, so sheer as this. From many personal experiences, I am convinced—though I may not be able to convince others—that there are those among us who either fail completely to understand, or if they do, are willing to misinterpret, the meaning of failure, every time panaceas are flashed in their eyes. They lack the understanding that failures in orthodontia are either the original or slightly changed conditions of malocclusion, which have been *treated* but *not corrected.* They also fail to understand that failures are either due to *incompetence* or to *unknown and uncontrollable factors* which interfere with the attainment of results. But even the factors, known to be the direct causes of failures, are numerous and variable. They need not be gone into now outside of mentioning the fact that *failures* present an entirely different problem from *relapses.*

Relapses, it should be understood, are disturbances occurring in cases which have been *successfully treated.* The term *relapse* is really a misnomer in orthodontia. *Relapse* means a return to a former bad state. The queer thing about relapses in orthodontia is that though there is a "return" to a "bad state," it is, usually, not exactly as it was before and, often, decidedly different. Failures and relapses share in common the fact that both are dilemmas to orthodontia. But what they do not have in common is the way out, though resorting to compromises makes it appear so.

The increasing trend toward, and reliability upon, compromises in treatment is deeply rooted in the illusion of a "cure-all," or in the belief of a simple solution to a complex problem—hence, the popularity. What is not so popular is the fact that there is vastly more we have to learn about orthodontia than what we *know* or what we *think* we know. Resorting to compromises, such as extraction of teeth in children without due regard for later consequences, is an arrogant assumption of cocksureness and a barrier to further progress, not to mention the injustice to the patient. Compromises may be permissible or even desirable, but only in *unusual* cases, and should be *considered as rare exceptions.* Even so, I should not choose to be held responsible for destroying the integrity of den-

titions in children who have not yet attained dental maturity. When it is done, in 50 per cent or even 60 per cent of the cases treated, as reported in New York, March 7, 1944, by Dr. Tweed, the mutilation of preadolescent dentitions seems to be taken much too lightly.

Compromises by extractions do not solve orthodontic problems whether of failures or of relapses. They aggravate them. Solutions depend primarily upon a thorough grasp and complete understanding of *all* the ramifications entailed in the problem. And no one has yet filed any exclusive claim on that. The fact that conscientious and highly competent orthodontists are annoyed by the crowding out of an incisor tooth from perfect alignment after it had been put there is very disturbing. But that the same orthodontists are highly gratified on having the incisors in "perfect" alignment at the sacrifice of four other teeth is rather alarming. To my way of reasoning, there is some quirk somewhere. Confidence in the promise that the incisors cannot do the same trick after the extraction of premolars must be considered just wishful thinking until proved to be otherwise. First it was third molars, now four more teeth. What next?

I, too, had daydreams when I first got started. When I came to, I learned that proof of experience usually turns out very differently. That is how I first learned something of great importance—that I had to learn more than I was sure I knew. One of the many things was that perfection in alignment of teeth in orthodontic practice cannot be measured as some do—by prosthodontic yardsticks. It sometimes strikes me as though the idea of setting the teeth on "top of the ridge" is an inspiration of prosthodontic origin. There are still some among us overlooking the fact that prosthodontia and orthodontia are concerned with the opposite extremes in the life cycle of teeth. The orthodontist is at the beginning, the prosthodontist at the end of it. The orthodontist aims at preparing the teeth for their life work, the prosthodontist to imitate them by artificial makeshifts.

Other things to know are that teeth of orthodontic patients are natural products of great antiquity. They are known to align themselves in a way which was acquired long ago and which has been transmitted from generation to generation for untold ages. Then, also, teeth do not get into alignment at one moment. They do not even appear all together.[8] There is real individuality in the coming of teeth. Some may join the mate on the other side of the jaw or an antagonist in the opposite jaw, but their independence is always identifiable. When they erupt they do it gradually. Some are faster, some slower. The singular thing about it is that few, if any, teeth start to erupt on the spot where they are going to serve when in functional action. They all keep on drifting there as long as they keep on erupting; and some do that even later. The end result is that, depending upon many circumstances which cannot be discussed now, some of the teeth actually do get into so-called "perfect" alignment, while very many more get into good enough alignment to perform satisfactorily their functions of mastication, speech, and whatever else is required.

The orthodontist is not content with good enough. It must be "perfect" to be of aesthetic significance. As a consequence, the alignment of teeth may be looked at from two orthodontic vantage points: One is the physiologic and

the other the aesthetic. The physiologic point of view is that teeth are of importance in so far as they perform those functions which are of biologic significance; such as, sustenance of life and preservation of health. To that end, the dentition should be "normal," though not necessarily what orthodontists consider as "perfect" or "ideal."

The aesthetic viewpoint is that teeth are of importance in so far as they enhance their own beauty by their form, size, and arrangement and the effect upon the beauty of the face. To that end, it seems that the most essential feature aimed at is "perfection" or "idealism," but *only* in alignment, even if it has to be gained at the risk of destroying anatomic integrity and physiologic efficiency.

If we examine carefully the teeth of people, living under conditions restricted by nature, environment, and circumstance, who must thrive on such necessities of life as are available without personal preferences, we are bound to learn a good deal about the real significance of teeth.* What is easily learned is that early in life the teeth among those people are relatively greater in number, better formed, in more favorable position and in better occlusion than among ourselves. That is, there are among them more individuals with far superior dentitions than among ourselves. But despite the greater frequency of superb dentitions in normal occlusion, it will be found that in none of them are the teeth so faultlessly aligned as to be considered orthodontically "*perfect.*" Thus, in twenty different racial groups with high percentages of superb dentitions in normal occlusion, I found that many among them (from 26 per cent in African Negroes to 71 per cent in American Whites) have one or more of the lower incisor teeth crowded or slightly rotated. According to prevailing notions and popular attitudes, such dentitions cannot be considered normal because they are much like those "relapses" occurring in cases with "bimaxillary protrusion." Judged by such standards, these dentitions should then be condemned to the loss of four premolars and the consequent effect upon occlusion.

As professional folks, we all too often seem to forget that "normal" in dentitions is not "perfection" and cannot be measured by celestial or divine standards. The "normal" in anatomical and physiological features need not be 100 per cent perfect to be adequate for the needs of life and health.[9] Moreover, it should be realized that the "normal" in multiple organs cannot be perfect because they are never uniformly identical either in size, position, or function. Even when just doubled, normal organs are not exactly alike. Handedness may be mentioned in this respect. Eyes, ears, arms, legs, fingers, and toes are other outstanding examples of dissimilarity, though not necessarily of abnormality. How can the dentition, consisting of so many more parts, be expected to be 100 per cent perfect even under normal conditions?

Does the orthodontist really think that he is better than Nature, Providence, or the Almighty, when he expects to attain 100 per cent perfection in reclaimed or salvaged dentitions, dentitions which started off and grew up under abnor-

*One need not go to the ends of the earth to do that. Our museums of natural history harbor enough samples of skeletal material to furnish sufficiently reliable information on that.

mal conditions, such as are presented by some of the extreme forms of malocclusion? If so, he might be reminded that the machinery he uses in doing it is far too dangerous. The damage he is inflicting, such as irritation of gums, resorption of cementum, dentine, bone, devitalization of teeth, is far too serious. Are such effects of orthodontic manipulation more favorable than the natural processes entailed in growth and regeneration under normal conditions? He might also be reminded that if those who are 100 per cent idealists would take the trouble to investigate their own dental or occlusal perfections and imperfections and try to find out what the real significance between them is, they would learn a great deal. They might at least learn to ponder on the significance of a comparison between a complete dentition with some crowded incisors or a crippled dentition with the incisors in even alignment. They might also ponder on what is to happen to those cases of decided malocclusion, who already have beautiful faces and whose teeth are by nature evenly aligned in their respective arches. And what about evenly aligned dentitions in normal occlusion with spaces between the teeth?

Answers to such questions rest on decisions which every orthodontist is obliged to make for himself. If compromise is the answer, then orthodontists need bother no further, because their problems are solved completely and forever. But it should be realized at the same time that solutions, based on compromises, also compromise fundamental principles and the allegiance to them. Already the word "racket" is becoming much too audible. If the conviction is that fundamental principles are essential and indispensable, then it holds out a challenge. The challenge is to meet exigencies as exceptions, but without curtailment of principles. This can be accomplished (1) by realizing the truth that the problem of failures and relapses is not enshrouded with the mysteries of mechanical wizardry alone, (2) by waking up to the fact that, besides incompetence which no one will admit, we are in almost complete ignorance of the specific factors causing relapses and failures, (3) by making the earnest attempt to learn more about them at once. Our hope therefore hangs on the decision to admit and face our failures or relapses, explore the unknown about them, and search for the reasons of their occurrence. It is certainly not by obscuring them with compromises that we can hope to find out what is bringing them about and how best to avoid them. In the glimmering light of cumulative evidence gathered from studies of my own experiences in the last thirty-three years, there is more than a ray of hope for success in a scientific solution of this problem. But until complete knowledge is available to explain more fully *why* relapses and failures occur, every effort should be exerted to abide by those fundamental principles which set orthodontia up and made the world take notice. Resorting to expedient compromises only serves to add on more orthodontic wreckage to that already piled up in the wake of panaceas that failed before.

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ORTHODONTIA A SPECIALTY IN ESTHETICS OR CORRECTION?*

The time has come when the orthodontic specialty has to make an unequivocal declaration to justify its existence. The present situation is such as to warrant the notion that any deviation, however insignificant, constitutes a malocclusion. The opinion of some orthodontists is that one misplaced tooth determines the occlusion of the entire dentition. That is, if one out of X factors of occlusion in a normal dentition is not correct, that dentition is in malocclusion. This tendency points to the inference that since the orthodontist treats malocclusion, therefore the justification is to treat all cases defined as malocclusion and to correct whatever is not perfect. The trouble is that malocclusion defined on such grounds leads to the inference that normal occlusion is *perfect* occlusion and that orthodontists do not tolerate anything but perfection. In reality, there is no perfection in occlusion. Anyone with experience in matters of this sort will attest to that. Dentitions of greatest excellence are never 100 per cent perfect in occlusion and orthodontic results are not invariably successful and not always perfect.

1. The origin of a notion of this sort is tied up with the foundation of occlusion of the teeth. The term malocclusion so generally used indicates the fundamental concept of teeth in their afunctional or nonfunctional aspect.

2. "Normal occlusion" was set up as the original goal for orthodontic achievement.

3. "Normal occlusion" was more talked of than known about. It entailed the normal number of teeth composing the dentition of man, the arrangement of teeth, and the form of the curve of the dental arch.

4. The esthetic aspect was first concerned with the alignment of the teeth; they had to be even, and their arrangement had to be in beautifully curved dental arches with the correct occlusal relationships between the teeth in the upper dental arch and those in the lower. The effect of such orthodontic procedure

*At the time of Dr. Hellman's death, he was in the midst of completing the manuscript of his studies of the results of forty years of practice and research. The following notes were written just a week before his death. They should be read with the understanding that they are only rough notes representing "leads" or themes to be expounded. Dr. Hellman took notes such as these and went over them again and again before ultimate presentation or publication. They represent his final thoughts in behalf of the profession to which he contributed so much. —*Editors.*

upon the looks of the face was at first considered as a by-product of success in establishing normal occlusion. Since beautiful faces are often found to be endowed with beautiful dentitions, it was assumed that in order for a face to be beautiful, the dentition must be in "normal occlusion." By further stretch of the imagination, the inference gained ground that to make an ugly face beautiful, all that was necessary was to establish "normal occlusion."

5. It was argued that one of the significant features in beauty is a beautiful dentition implying, of course, a full complement of teeth in regular alignment and in "normal occlusion."

6. To attain that end, *conservation* and *restoration* were the chief means resorted to.

The *dentofacial* aspect then appeared and confused the original issue:

1. From the dentofacial aspect, the occlusal viewpoint was considered as a *detached* or secondary problem.

2. The dentofacial adventists argued that the orthodontic problem must be changed by looking at the teeth from the aspect of facial esthetics.

3. The face was the predominating feature and the teeth were of secondary consideration. The teeth must not be dealt with from the occlusal side, but from the beauty values as it may benefit the face.

4. From this aspect, the teeth began to look too big for the size of the jaws, the jaws too small for the size of the teeth, or both too big or too small for the size of the face. The size of any of these features is, of course, not standardized and the too small or too large is just arrived at by guess.

The Influence of the Surgical Tradition:

1. Dentistry started out with a record of pulling teeth.

2. Orthodontia trailed behind it.

3. The practice of orthodontia originally depended on tooth pulling. The only problem was *which* of the teeth were to be eliminated.

4. Angle changed the radical procedure of elimination to the conservative ideology of preservation.

5. Now under the pressure of modern outlook on beauty, no sacrifices are too great to gain an end.*

6. Beauty nowadays is not cultivated. It is made.

7. Technical skill and economic compensation furnish the incentive.

8. Teeth are not just preserved on a natural and normal basis.

9. If not suitable to fancies and whims, they are changed in position or in form, and if that is not enough they are removed and replaced by manufactured and specially designed substitutes.

10. If the teeth alone won't improve the face to satisfy its owner, the nose too comes in for a share in the desire and pursuit of beauty.

11. Of course, eyes too, lips, and face-lifting in general just bear additional proof of the mad rush for glamour and beauty and the various rackets which have been established around them.

12. Is the orthodontist a beautician or a pediatrician?

*The trend of extracting teeth again to benefit the face is evidence that occlusion has been entirely discarded.

SOME CONDITIONS NOT FAVORABLE TO ORTHODONTIC PROCEDURE*

MILO HELLMAN†

CONDITIONS pertaining to teeth and occlusion, judging from general observations, always seem to warrant orthodontic procedure. The glamour of orthodontic appliances may not be irresistible. Nevertheless, it certainly is potent enough to obscure the prevalence of unfavorable conditions and, at times, even to obstruct the view of the desired goal. When one kind of appliance has lost its fascination, another is resorted to, the trend being to do little with many instead of much with any. It obviously is not realized that usefulness in procedure rests upon effectiveness in overcoming obstacles. It is my conviction that changes in procedure are made at cost of attainment. What people fail to see is that frequency in changes of procedure does not eliminate difficulties. It just multiplies them.

The conditions to which I shall refer are fundamental and paradoxical. Though indicating orthodontic procedure, they are not favorable to it. Of course, I mean by *condition* an event, fact, or the like, necessary for the occurrence of some other event, fact, or the like; i.e., a prerequisite to its fulfillment. I do not mean or infer any implication of cause. The conditions not favorable to orthodontic procedure, like those unfavorable to human happiness, are far too numerous for a complete account. I shall, therefore, limit my talk to just "some" conditions, dealing only with those with which I am familiar and have had sufficient experience to be convinced of their importance and significance.

However, to understand conditions properly which are not favorable to orthodontic procedures, it is necessary to mention some general facts which, in my estimation, are not only elementary and fundamental, but also indispensable. The first is that malocclusion of the teeth is in a sense a deformity closely associated with or related to development, in so far as the teeth, jaws, and face are concerned. The second, that the aim is to correct this deformity by orthodontic procedures. The third, that to correct malocclusion of the teeth, mechanical devices are employed in the form known as orthodontic appliances. The last and most significant is that by using mechanical devices to correct malocclusion, it is of utmost importance to take all precautions *not* to disturb the normal physiological balance of the tissues involved. In other words, orthodontic procedures aimed at correcting malposition and malocclusion of *the* teeth should

Read before the Section on Pathodontia, First District Dental Society of the State of New York, New York City, Nov. 16, 1942.

*Published posthumously by the Northeastern Society of Orthodontists.

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begin with normal and healthy tissue conditions. The task and responsibility of the orthodontist is then to keep them healthy, and forestall disturbances which might produce disease coincident with the restoration of normal occlusion. It is somewhat paradoxical to address the Section of Pathodontia on how to avoid pathological conditions instead of how to cure them.

Through the researches of Albin Oppenheim,[1, 2] with which most orthodontists are and all should be familiar, the fact forcefully disclosed is that *all orthodontic procedures are injurious* to the tissues surrounding the roots of the teeth. From the very beginning, throughout the course of procedure to the very end of orthodontic treatment, the cementum, the peridental membrane, the alveolar bone structure, the gums, the nerve and blood supply are all subjected to traumatic injury. Oppenheim demonstrated microscopically, of course, that even the insertion of a separation, preceding the adjustment of orthodontic appliances, does some injury to the cementum covering the roots of the teeth being separated. The dentist, too, might think of this fact when teeth are "wedged" apart for the insertion of fillings. The further adjustment of bands, wire arches, ligatures, springs, and all the other paraphernalia used in orthodontic practice intensifies the damage done.

Many orthodontists apparently were, and some still are, oblivious to these occurrences until some unforeseen incident happens. Then they are suddenly surprised to find the roots of some of the teeth half missing or entirely gone. Credit should be given to Ketcham[3] for bringing this fact to the attention of the profession. But, important as this knowledge is, the time when such injuries are discovered is too late for anything to be done about them. Far more important now is Oppenheim's discovery of the beginnings of these troubles, because if heeded at the outset, the danger lurking ahead will be avoided before it is too late.

Oppenheim's investigations, though still in progress, are far enough advanced to warrant the following generalizations: (1) Orthodontic treatment, as it is known today, is a mechanical procedure of aligning teeth which in turn depends on *biological responses* of the tissues surrounding their roots; (2) since teeth are being moved about by mechanical devices, the tissues holding them must respond in such a way as to favor and further the task; (3) the response of the tissues thus taking place is in a sense a natural attempt to readapt their structural organization so as to maintain their normal hold upon the teeth being changed in position. In technical terms, the effect of the mechanical force is to produce a biological response.

Now, appliances do not accomplish these things. Intelligence is needed for that. The appliances just push the tooth crowns about. It is the orthodontist who makes the appliance and it is he who makes the appliance do it. If he does what he aims to do and is skillful, careful, thoughtful, and cautious about it, the tissues damaged in the act of doing will manage to recuperate by regeneration. In other words, injury is always inflicted in orthodontic procedures. The tissues depend upon opportunities to rest and recuperate, and they will regenerate if the injury is not too severe and sufficient time is allowed between visits. If the orthodontist is too anxious, too clumsy, or fails to recog-

nize what is going on under the surface covering of the mouth cavity, there is more damage done than regeneration is able to repair. The effect then is not only unfavorable, but also cumulative. When it is discovered, it is too late. On this account, it is of utmost importance to make sure in advance, before beginning with orthodontic treatment, that, as far as can be ascertained, the tissues are healthy and the roots of the teeth are completely developed. Incompleted roots, diseased tissues around them, or both together do not respond to mechanical stresses and strains in the same way as do healthy and completely developed ones. Incomplete roots tend to be deformed,[4] and diseased tissues tend to intensify the trouble and interfere very significantly with the kind of reactions necessary to overcome the injury of orthodontic appliances and attain a successful result.

Due to these primary conditions, there are two prerequisites in orthodontic undertakings which should not be overlooked. One is to take full cognizance of those conditions which are entailed in successful orthodontic achievement, and the other is to be sure of a similar complete appraisal of all those conditions which might interfere with reaching the desired goal. It needs no special mention that the conditions interfering with successful treatment are far more numerous, far more obscure, and far more complex than those aiding the achievement of satisfactory results. If the orthodontist would be as familiar with them as he is, or should be, with the mechanism he is using, chances for success would be far better than they seem to be now. The trouble is that orthodontists know appliances most and handicaps least.

However, taking it for granted that malocclusion of the teeth and the actual machinery for correcting it may be satisfactorily disposed of, a good deal can still be learned by taking the circumstances alone into account. The conditions not favorable to orthodontic procedure may then be divided into two general categories. According to the two participants in orthodontic ventures, they may be assorted into: (1) *subjective* conditions or those relating to the orthodontist; (2) *objective* conditions or those relating to the patient.

SUBJECTIVE CONDITIONS UNFAVORABLE TO ORTHODONTIC PROCEDURE

The most obvious subjective conditions not favorable to orthodontic procedure are brought about by lack of certain qualifications and requirements the operator should possess. They are roughly the following:

1. Lack of complete and thorough grasp of the nature, principles, mechanical details, and variation in occlusion of the teeth.
2. Lack of ability to discriminate differences in form of dental arches.
3. Lack of complete and thorough understanding of the principles of mechanics of orthodontic appliances and their effect upon the teeth and surrounding tissues.
4. Lack of adequate alertness in watching the behavior of appliances during the course of treatment.

1. *Lack of Complete and Thorough Grasp of the Nature, Principles, Mechanical Details and Variation in Occlusion of the Teeth.*—The question of occlusion is traditionally a fundamental subject in orthodontia and should not be men-

tioned at all. In the Angle School era, it used to be considered as significant and as elementary in orthodontia as spelling is in literature. The reason for mentioning it is that orthodontic education now is not what it was then and that the orthodontists practicing now far outnumber those of the Angle School era. The trouble with orthodontists now is that, in the mastery of handling the many and complicated mechanisms, and in the acquisition of the highfalutin vocabulary enabling them to talk glibly on biology, physiology, growth, dentofacial development, gnathostatics, cephalometrics, and what have you, they seem to be skipping some important letters of the orthodontic alphabet. Occlusion, as I have abundant occasion to notice, is now either taken for granted or just ignored. At the Angle School, at least as I knew it, the students used to be drilled daily in the occlusion of the teeth just as children in elementary schools used to be drilled in reciting the multiplication tables. The point is, judging from reliable evidence in my possession, some of which has already been published,[5] and more will be later on, I am convinced that the knowledge of occlusion among those practicing orthodontia is either not taken very seriously or entirely confused, and that many predicaments in treatment are unavoidable because of it. Note, for instance, the results shown in Figs. 10 and 11. A complete rebirth or at least a rejuvenation of studies in occlusion in my estimation is imperative if orthodontic procedure is to be satisfactorily justified.

2. *Lack of Ability to Discriminate Differences in Form of Dental Arches.*— The ability to distinguish form is subject to certain inherent shortcomings. There are certain states of perception which hamper total or partial subjective appreciation of objective phenomena. Tone deafness, for instance, hampers one in appreciating differences in sounds. Color blindness has the same effect upon the appreciation of differences in color. I am not so sure that like conditions do not affect total or partial appreciation of morphological variation. It has often been observed that certain people are not quite able to discriminate between differences in form and others not even between differences in outline. Optical illusions are not founded on imaginary phenomena alone. They are possible because of certain inefficiencies in our sight. Astigmatism is a good example. In orthodontic procedure, inadequacies of this sort are serious handicaps. Direct references to them have hitherto been entirely ignored. But that they do exist, though not directly denied, is indirectly admitted by the use of certain helpful aids and by the outcome of certain results without or despite those aids. Hawley[6] obviously took notice of this fact, because, already at the turn of this century, he devised an outline pattern to which he thought all dental arches should conform. It became very popular too. I have known a number of orthodontists, the best of them, who have been and some who still are guided by the outline of the Hawley arch forms. By superposing celluloid cards on the casts of the patients' dentitions, orthodontists try to copy the outline as designed on the card.

Later on, Stanton[7] also recognized the fundamental trouble in perception of form. He, too, made a creditable effort to overcome it by helpful devices. His was a more elaborate procedure and required the skill of experts in engineering to complete the necessary machinery and special assistants to handle it. As

it happens, neither of these schemes survived the reality of achievement, as it is measured by the inexorable test of time. A serious slip was made by both Hawley and Stanton. They both regarded the "tooth material" as an amorphous physical mass. They measured its bulk by linear dimensions which were used to construct the form of the dental arch. It did not dawn upon them that: (1) the "material" used to construct dental arches cannot be altered to suit the designs in form, and (2) the form of the dental arch must be based upon the inherent form in which the "material" comes, i.e., the individual form of the teeth themselves.

It was my guess or hypothesis, if you will, that the form a dental arch must assume is predesigned by the form of the teeth—the blocks—composing it. Thus, if the teeth being aligned are correctly put together, they will form the proper arch form, just as the pieces in a jigsaw puzzle when properly put together form the appropriate picture. Of course, I made this guess after extensive studies in comparative and human dental morphology.[8, 9] When put to test, it actually worked. In the figures are given a few striking examples of how it worked out. Fig. 1 shows a case of malocclusion, Class I, Angle. The teeth are as much out of place as is the dental arch out of form. I followed the forms of the teeth to construct their dental arch, and, by restoring "normal occlusion," the relationship between the dental arches was established and maintained. The sweeping and symmetrical form of the dental arches may be seen by following the line of the cutting edges of the incisor and canine teeth, and the buccal marginal ridges of the premolar and molar teeth in the occlusal views of Fig. 2, showing the result after treatment. Another example is shown in Fig. 3. This example is of a case of malocclusion, Class II, division 1, Angle. In this case, too, the principles guiding the treatment were the same as before. Fig. 4 shows the result obtained in this type of case. A third example is illustrated by Fig. 5. This case is one of the most extreme Class II, division 2 types that ever came under my care. The shrunken form of dental arch and lack of occlusion are obvious. What is not so obvious is that there are only three lower incisor teeth. One was accidentally extracted during a dental operation. Fig. 6 again shows the result. To complete this evidence, Fig. 7 is presented to show the way this procedure worked in Class III malocclusion. Fig. 8 shows the result. In this series of illustrations are samples of each of Angle's classes of malocclusion. Each malocclusal condition was different. The resulting arch form in each case was different too, but all of them are beautifully sweeping in form and symmetrical in structure. Of course, it should be understood that these are but *samples* of large numbers of cases similarly treated with like results. They are intended to convey the idea of what results look like when the principles roughly outlined above are carefully and conscientiously carried out.

I shall now show the alternative with the illustrations of some treated cases in which the results warrant the suspicion that neither these nor any principles were followed. Of these cases, too, there is a large collection in my possession. At this time, however, just two samples will do. In Fig. 9 are seen the casts of the dentition of a boy 11 years old with Class II, division 2 subdivision maloc-

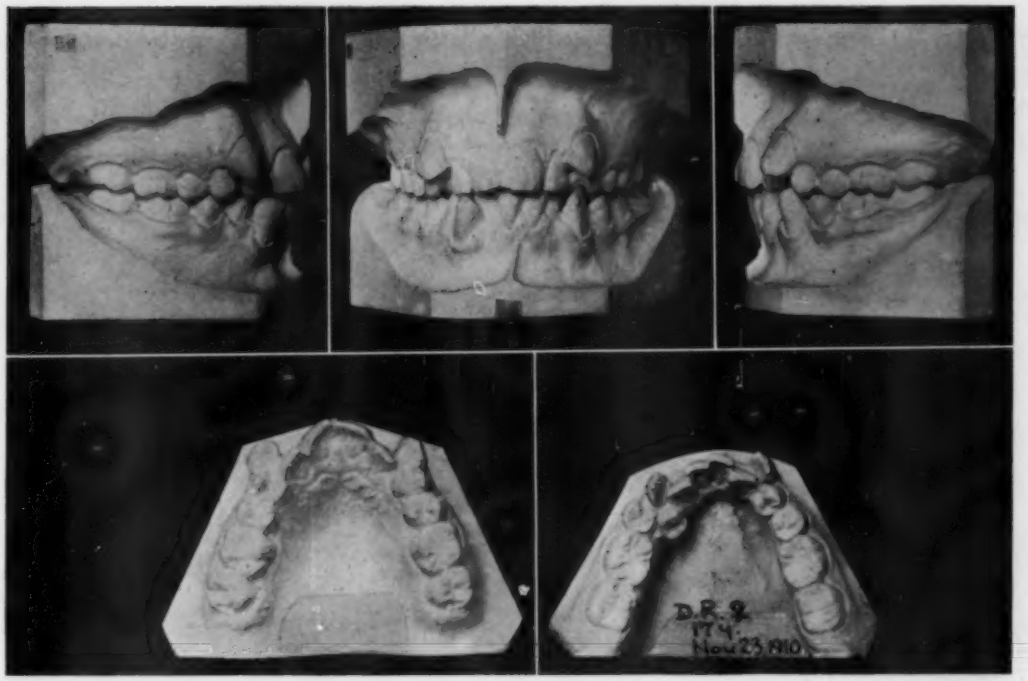

Fig. 1.—Casts of dentition of girl, aged 17 years, in Class I malocclusion (Angle), showing extreme malposition of teeth and distortion of dental arch.

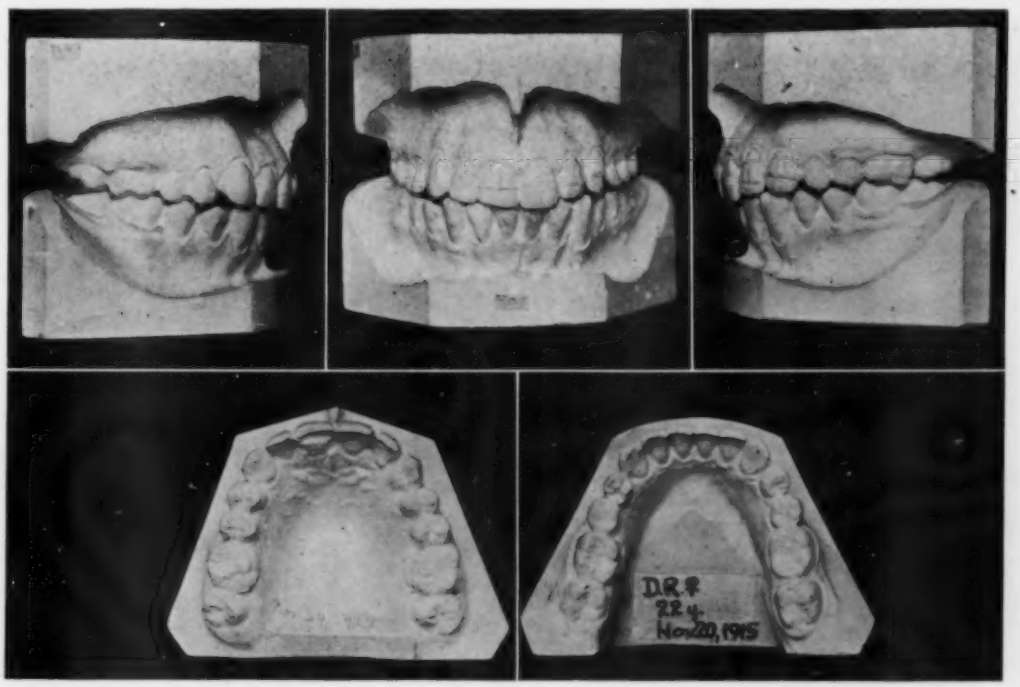

Fig. 2.—Casts of dentition of same patient as in Fig. 1, showing result in occlusion of teeth and form of dental arch.

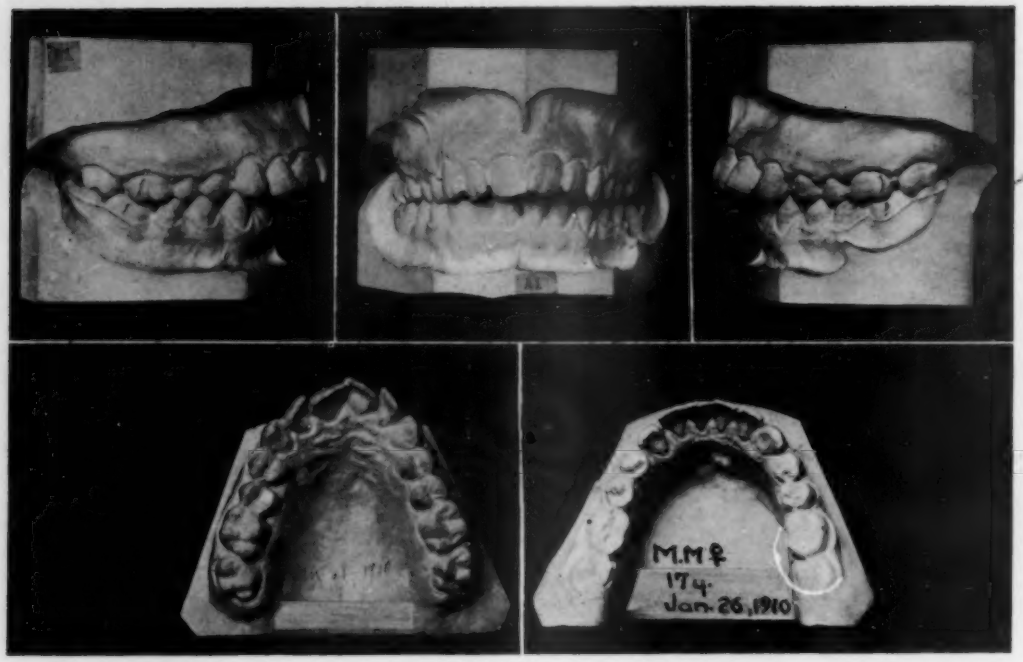

Fig. 3.—Casts of dentition of girl, aged 17 years, in Class II, division 1 malocclusion, showing marked rotation and crowding of front teeth, and complete disturbance in antero-posterior relationship between the dental arches.

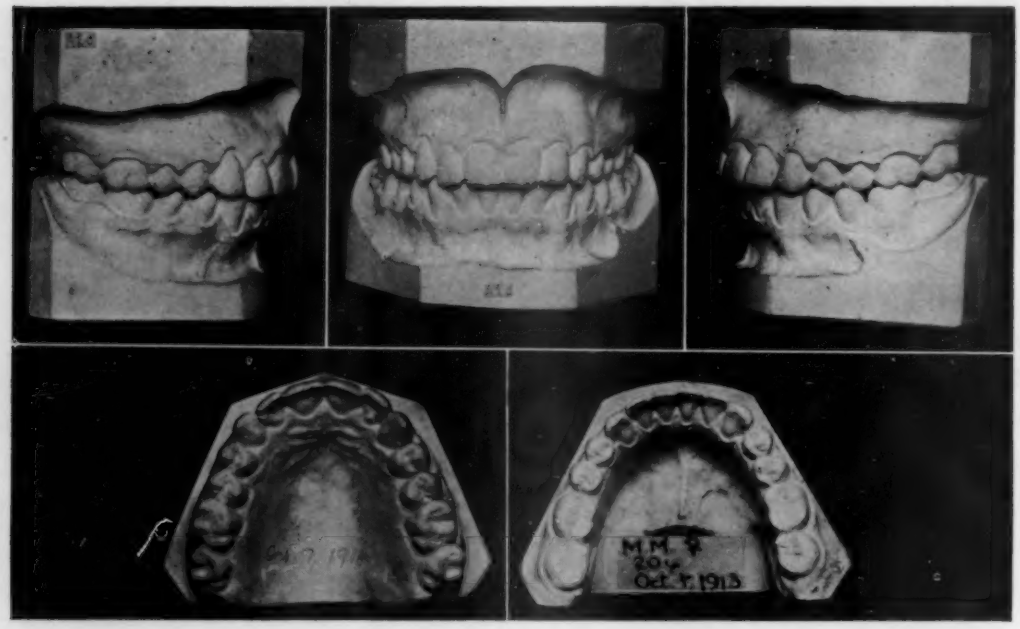

Fig. 4.—Casts of dentition of same patient as in Fig. 3, showing the result after treatment.

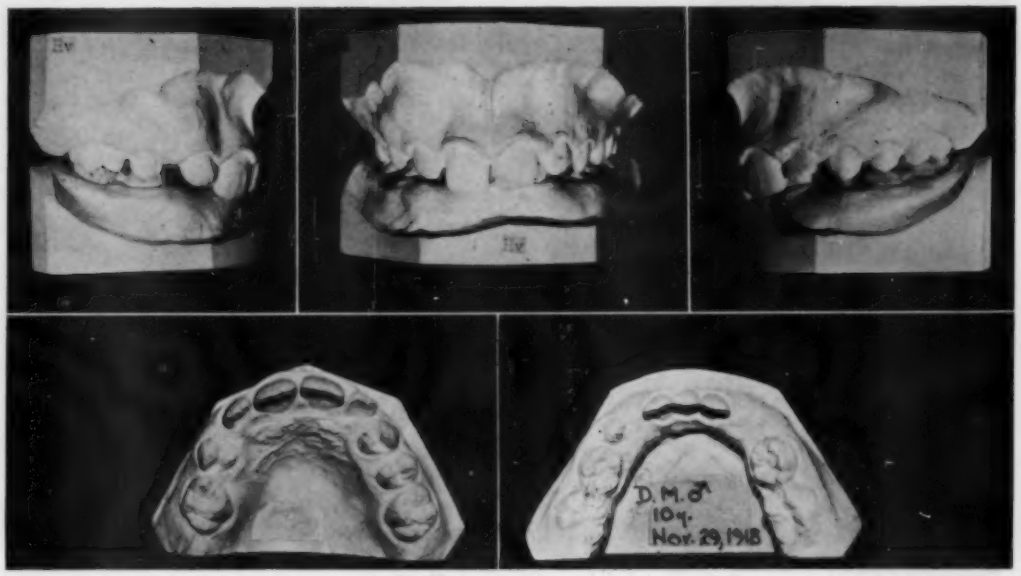

Fig. 5.—Casts of dentition of boy, aged 10 years, with very marked Class II, division 2 malocclusion.

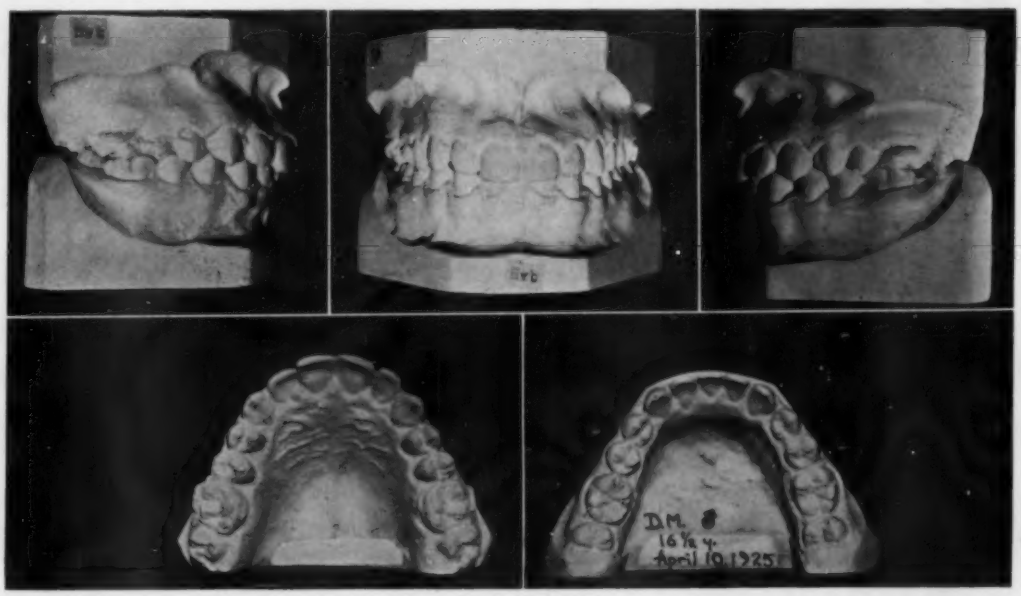

Fig. 6.—Casts of dentition of same patient as in Fig. 5, showing result after treatment.

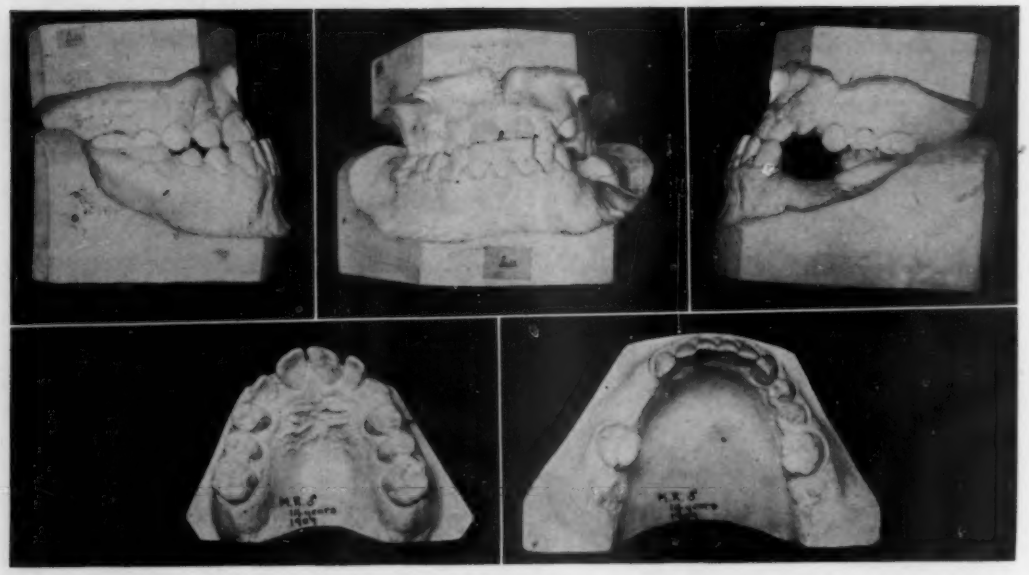

Fig. 7.—Casts of dentition of boy, aged 14 years, with marked Class III malocclusion, showing diminished upper and enlarged lower dental arches.

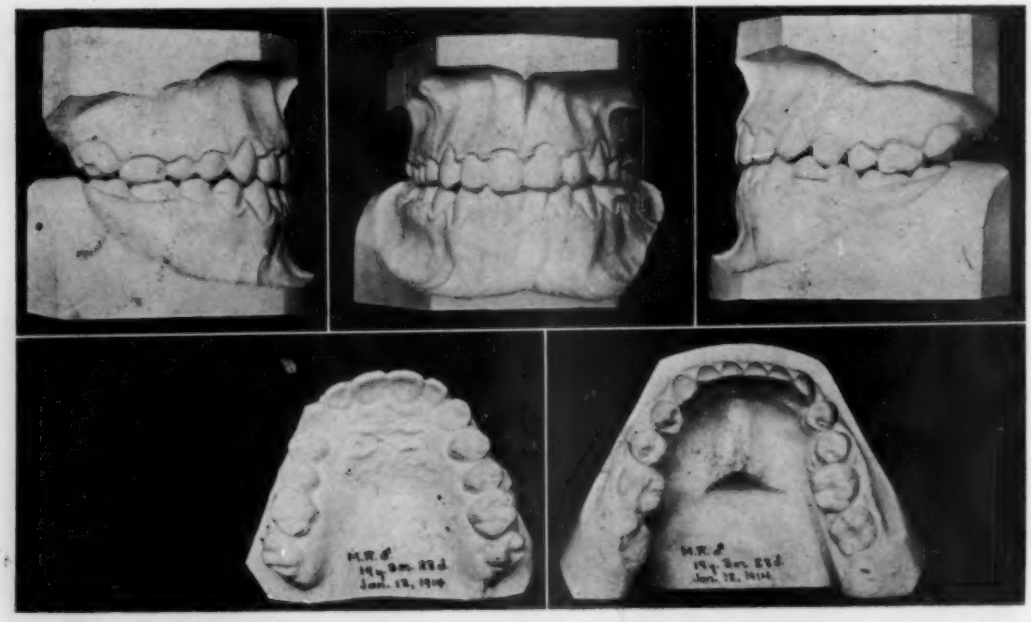

Fig. 8.—Casts of dentition of same patient as in Fig. 7, showing result after treatment.

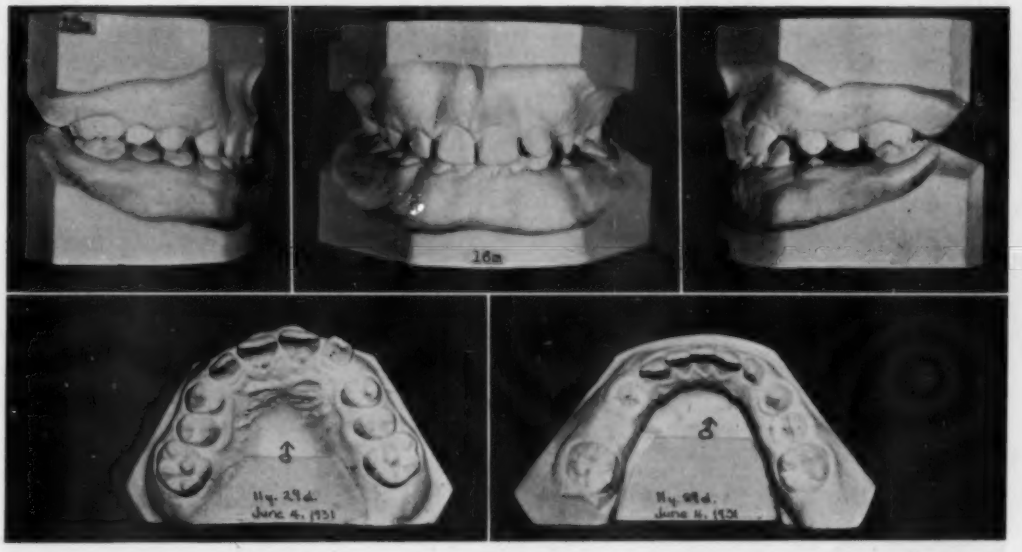

Fig. 9.—Casts of dentition of boy, aged 11 years, in class II, division 2 subdivision malocclusion, showing considerable similarity to the case shown in Fig. 5.

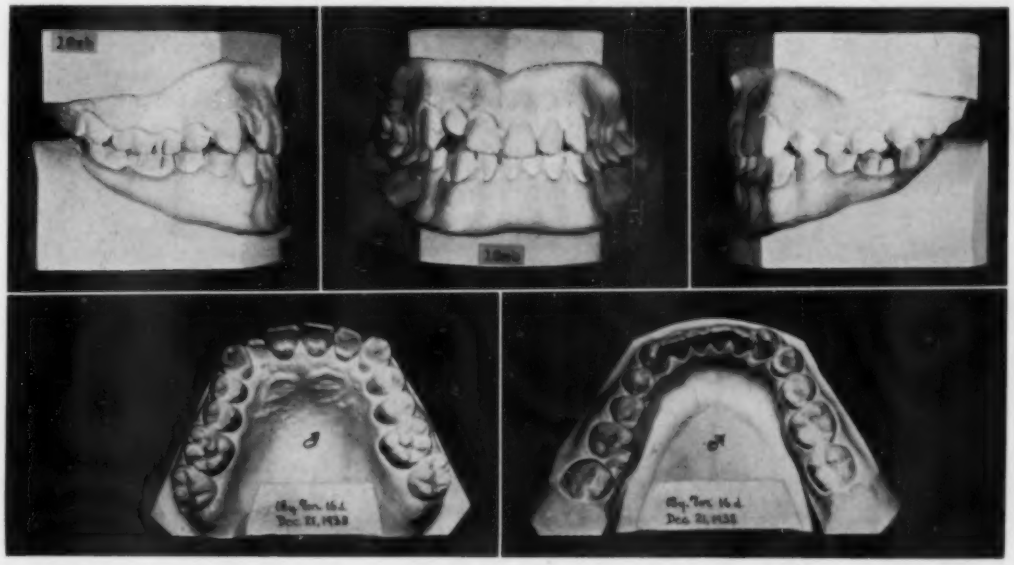

Fig. 10.—Casts of dentition of same patient as in Fig. 9, showing result worse than original condition both in occlusion and dental arch form.

clusion. This case is not much different from that shown in Fig. 5. In Fig. 10 is shown the result after seven and one-half years of orthodontic treatment. The occlusion in this case is really worse than it was originally, and the alignment of the teeth is anything but that of a dental arch form. This result should be compared with that shown in Fig. 6. The result of this case, however, is surpassed by the condition of the dentition shown in Fig. 11. These casts are of the dentition of a boy 16 years of age. At the stage shown, he had had orthodontic treatment for six years. The question I was called upon to decide was whether treatment should be carried on or not. There is no need for further comments to prove the truth of the caption to point one and point two. It certainly is clear that these illustrations, besides showing the incredible forms that dental arches may assume, also indicate complete disregard of occlusion.

Fig. 11.—Casts of dentition of boy, aged 16 years, showing occlusion of teeth and form of dental arches obtained after six years of orthodontic procedure.

3. *Lack of Complete and Thorough Understanding of the Principles of Mechanics of Orthodontic Appliances and Their Effect Upon the Teeth and Surrounding Tissues.*—I have stated previously that if the orthodontist would be as familiar with the conditions favoring and those not favoring orthodontic achievement as he is, or should be, with the mechanism he is using, the chances for success would be much better than they now appear. The trouble is that orthodontists are interested in appliances most and handicaps least. But, even so, occurrences such as shown in Fig. 12 are not quite explainable. It is difficult, for instance, to understand why in this case the appliance is absolutely in reverse. Anyone should know that if it is the intention to put the upper right

canine where it should be, the appliance as adjusted, if it will do anything, will prevent it. This illustration just shows that the one doing this job did *not* know it. This is so glaringly obvious that it is difficult to realize that it is actually so. It should, however, be emphasized that I have two other like cases in my collection.

Fig. 12.—Occlusal view of casts of upper dentition of young lady, showing *A*, upper right canine erupted on palate behind upper lateral incisor; *B*, appliance in position, with which it was attempted to put malposed tooth into proper position.

4. *Lack of Adequate Alertness in Watching the Behavior of Appliances During the Course of Treatment.*—It may be considered an exaggeration to say that more teeth are being dislodged by unnoticed distortions and unobserved defects in orthodontic appliances than are being put into normal position by effective control. Orthodontic appliances, if not watched carefully, are not trustworthy. Anyone knowing them at all will admit that they are often likely to play unexpected tricks. Orthodontists using appliances of any kind are not always sufficiently on the alert to ward them off. It is known that sometimes orthodontists fail to succeed in making appliances do what is desired. But there are other times too when the appliances also do what is *not* desired. Note, for example, Fig. 10. I am sure that the aim in the treatment of this case was not what is actually accomplished, although it took seven years to do it. But, in addition to "having missed the boat," so to speak, the trail left behind shows the damage done in going. It is difficult to imagine that the dislocation of the lower left permanent first molar was really intended. It was just not noticed when it happened. As shown in Fig. 9, this tooth was in perfect position before treatment. Of course, this is a gross exaggeration of what might happen. But there is available a large enough number of like and intermediate examples to fill in any gap between zero and this grotesque situation.

The conditions named in the first category are only a small part of those unfavorable to orthodontic procedure. But enough has been said to warrant the inference that the problem, though elementary, is not a simple one. There are, then, those conditions which are in the second category to be accounted for.

OBJECTIVE CONDITIONS UNFAVORABLE TO ORTHODONTIC PROCEDURE

The objective conditions are very numerous, much discussed, little understood, and mostly confused. I must confess to being not so familiar with them as with the subjective ones. Some conditions, however, may be mentioned:

1. Lack of satisfactory economic arrangement.
2. Lack of willingness of patient to submit to orthodontic treatment.
3. Lack of willingness of patient to follow instructions and cooperate with the orthodontist in the achievement of a satisfactory result.
4. Lack of discipline or control of unnoticed pernicious habits which tend to defeat the objective in orthodontic procedure.
5. Lack of proper dental collaboration.
6. Presence of pathologic conditions.

1. *Lack of Satisfactory Economic Arrangement.*—In many instances, this is the most important condition for orthodontic procedure. It definitely overshadows all others. Experiences of the past warrant the statement that if the fee is high enough no other condition is sufficiently unfavorable to prevent undertaking orthodontic procedure. There are instances when orthodontic treatment is inadvisable, and at times even contraindicated. There is, I am sure, almost unanimous agreement on that. But, as far as I know, this is not taken seriously by orthodontists and never put bluntly to the parents or patients. Instead of making it clear that certain malocclusal conditions are better left alone, the fee to correct them is put so high as to be out of reach. What would happen if the fee were paid? An actual experience might explain that.

At the beginning of my orthodontic career, a child was brought to me for orthodontic treatment. It was a girl, 10 years of age. Her dentition was definitely in malocclusion. But, unfortunately, she also had a condition of pyorrhea. It was as bad a case of pyorrhea as I had ever seen in an adult. Of course, the child at the same time was not particularly good-looking. The father had in mind the publicity given to orthodontic achievements in developing chins, growing jaws, and changing facial expression. He had set his heart on having this child's looks improved. I told him what the child's mouth needed first and foremost was health, and advised him to have the proper dental attention. He insisted on orthodontia. I declined, but, on his insistence, I referred him to one of the most outstanding orthodontists in New York at that time. Upon getting to the authority recommended, I was telephoned and asked what was wrong that I sent him the patient. Of course, such procedure was unheard of then and I am not so sure whether it is very fashionable now. I said there was nothing wrong. I just felt that I was not able to cope with the condition, and thought that he was better able to do it. He asked whether there were any unsettled financial obligations. I said, "No"; so he accepted the case. What the outcome was, I do not know. It is anybody's guess.

2. *Lack of Willingness of Patient to Submit to Orthodontic Treatment.*—It should be realized that despite the fact that parents are always anxious and

eager to have their children's teeth straightened, some of the children are not. The children who are not willing usually submit, but always show indifference, sometimes resentment, and often, also, opposition. In either case, the task of orthodontic procedure is made difficult, stretched over unreasonable lengths of time, and the result invariably impaired. To begin with, the enthusiasm, spontaneity, and zest of the operator is always dampened, if not actually frozen, by the indifference and disinterestedness of the patient; and, secondly, the work

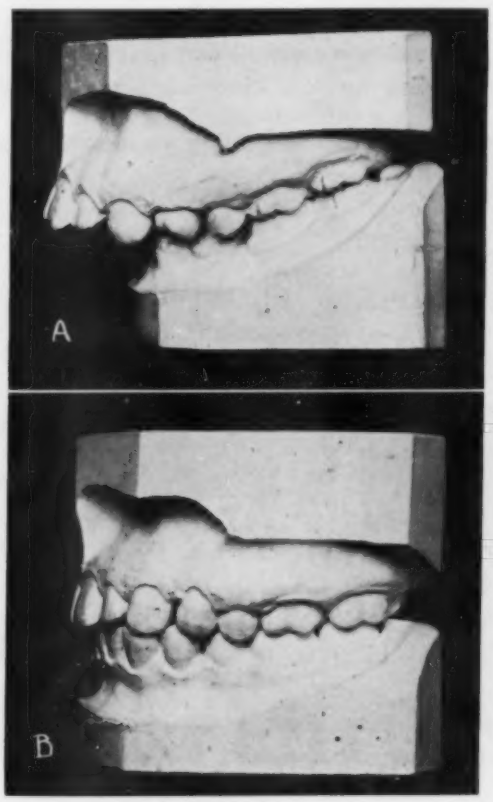

Fig. 13.

Fig. 14.

Fig. 13.—Side views of casts of dentition of girl in Class II, division 1 malocclusion, showing *A*, occlusion before beginning; *B*, after completion of treatment.

Fig. 14.—Photographs of profile of girl whose dentition is shown in Fig. 13, showing *A*, facial profile before; *B*, after treatment.

is always hampered by intentional vandalism and mischievous pranks. Achievement of a good orthodontic result is a most arduous task at best, but, under handicaps, it is apt to become impossible, if patience and perseverance are likely to run low. I have gone through such struggles with one of the most difficult cases, and not until the end was achieved did I succeed in convincing the patient of the justification of treatment and the condemnation of her opposition. Fig. 13 shows two side views of the casts of that case: *A*, at the beginning, and

B, at the end of treatment. The result was very gratifying. The change in the facial features is shown in Fig. 14, *A* and *B*. Originally, the young lady was of the opinion that it was stupid for an intelligent person to fuss around with teeth. And she missed no opportunity to impress the fact that only mercenary reasons could induce one to do it. When she saw the change shown in Fig. 13, *B*, and Fig. 14, *B*, she admitted that she was wrong. But it took five years of patience and perseverance to make her see it.

3. *Lack of Willingness of Patient to Follow Instructions and Cooperate With Orthodontist in the Achievement of a Satisfactory Result.*—Willingness of some patients to submit to orthodontic procedure is sometimes easily agreed to, but unwillingness to cooperate is difficult to overcome. Some orthodontic patients are under the impression that tinkering with the mechanical gadgets in their mouth is a sort of game. Many of their friends assure them that it is an enjoyable game. If such views and information are not discovered *before*, there is

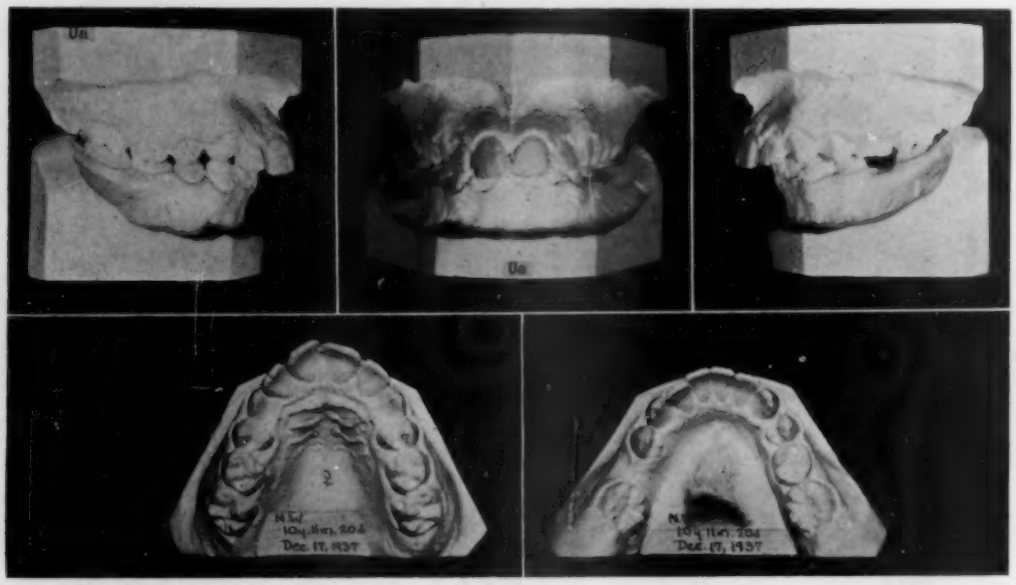

Fig. 15.—Casts of dentition of girl, aged 11 years, showing Class II, division 1 subdivision malocclusion at beginning of treatment.

a heavy penalty paid *after*, in the form of disappointments, discouragements, and actual injury, not only to the operator's temper, but also to the patient's teeth and their surrounding tissues. If the help of parents is sought, it is not always sure to come. It should be emphasized that some parents are extremely helpful. But there are others who take the attitude that it is your job and your responsibility. Their task was to hire you to do the job, and, in so far as they are concerned, their part is done. In Fig. 15 are shown the casts of the dentition of a girl, 11 years of age. She had this idea in mind when treatment was started and lost no time in putting it into execution. I warned her that it would not work. She paid no attention. All warnings and threats went to naught. She was a very bright child at that. I was convinced of my ability to obtain a very

good result and felt frustrated in the attempt. After eating my heart out for five months, the case was actually worse than before. I was sure that this sort of bungling would end in disaster. Summer was approaching and the girl was going to camp. I told her that because of her attitude I was obliged to discontinue with the treatment. I removed the appliances and sent her home impressing her with the fact that her mouth was worse than when treatment was started. I also told her, in the presence of her mother, that she need not come back because I was through with the job. But I did suggest that if she would change her attitude in the fall, I might change my mind. If she would admit, upon her return from camp, that this failure was her fault, apologize for it and promise to cooperate, I would be glad to start all over again in the fall. In September, she reacted just as as I had hoped she would. I started in again, she was very helpful, and in nine months the treatment was completed with the result shown in Fig. 16.

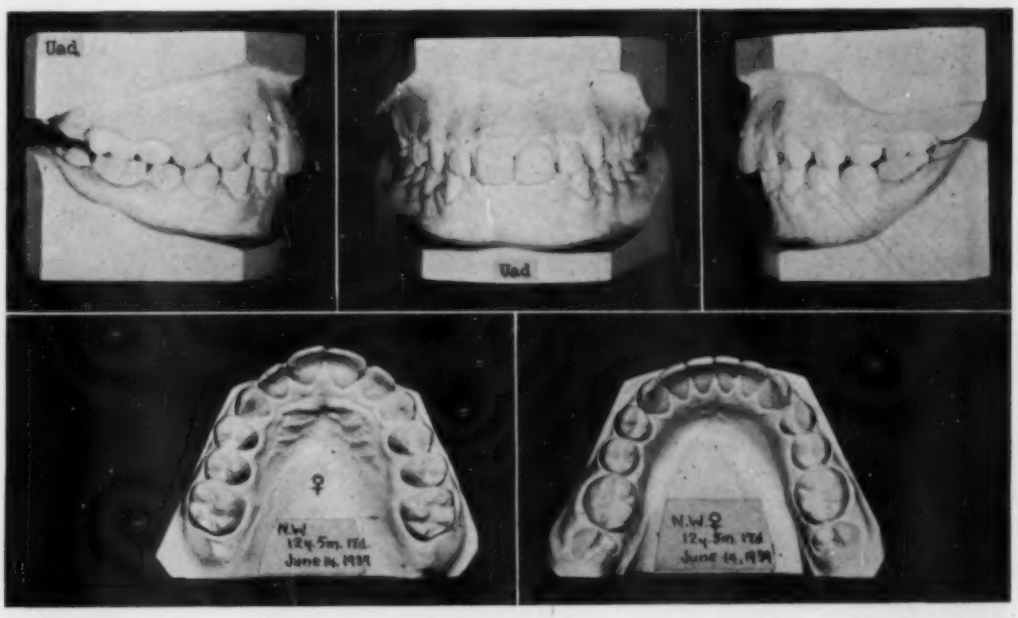

Fig. 16.—Casts of dentition of same patient as in Fig. 15, after 9 months of treatment in which she cooperated, showing satisfactory result.

4. *Lack of Discipline or Control of Unnoticed Pernicious Habits Which Tend to Defeat the Objective in Orthodontic Procedure.*—There are patients who unconsciously and repeatedly do certain things which are bound to become uncontrollable. Practices of this sort often become habits which cannot be broken. Such conditions are unfavorable to orthodontic procedure. Angle called such practices pernicious habits and maintained that they constitute a cause of malocclusion. I stated at the outset that I shall not deal with causes at this time. I will, however, refer to some of the pernicious habits as constituting conditions unfavorable to orthodontic treatment. Habits such as thumb-sucking, or just biting off the nails, or nibbling at the cuticle around the nails, biting the lower lip or the inside of the cheek are practices which are widely known to

play havoc with the effort during treatment and with the results after. It is also well known that some habits are not so easily broken, and some not at all. A grandmother once confided that there is nothing which gives her more satisfaction than putting her thumb into her mouth. A young mother, a former child patient, admitted practicing this habit even now. It is not different with other habits.

The effect of such habits on orthodontic procedure is always detrimental. In some cases, no progress is possible at all, or when some progress is made, it is gained at an unreasonable cost in effort, energy, and money. Even when a satisfactory orthodontic result is obtained, in cases where the practice of a habit is suspended for a time, or in spite of it, the achievement is not of long duration after the retaining appliances are removed. Two unusual cases of unnoticed pernicious habits from my practice are shown in the following illustrations. In Fig. 17 are shown the casts of the dentition of a boy, 11 years, 9 months of age. The occlusion was in Class II, division 1. The youngster was very anxious and extremely cooperative. He denied the existence of any habits at the beginning. Treatment was completed in eight months. Fig. 18 shows the result.

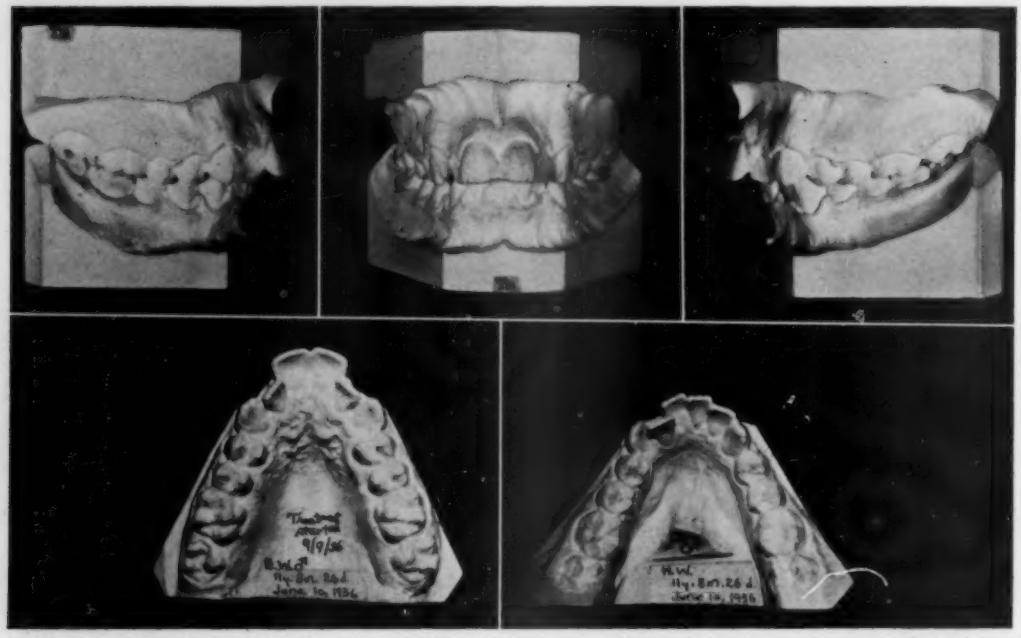

Fig. 17.—Casts of dentition of boy, aged 11 years, 9 months, showing Class II, division 1 malocclusion before treatment.

Retention was then adjusted. Six months after the removal of the retention, the lower incisors were becoming crowded. The patient denied doing anything which might bring it about. Fig. 19 shows the casts of this case four years later. While the mesiodistal relationship of the premolar-molar series is retained, the front part of both dental arches is completely collapsed. After long discussions, arguments, and inquiry, the father finally mentioned and the boy admitted that when studying, thinking, or otherwise preoccupied and not conscious

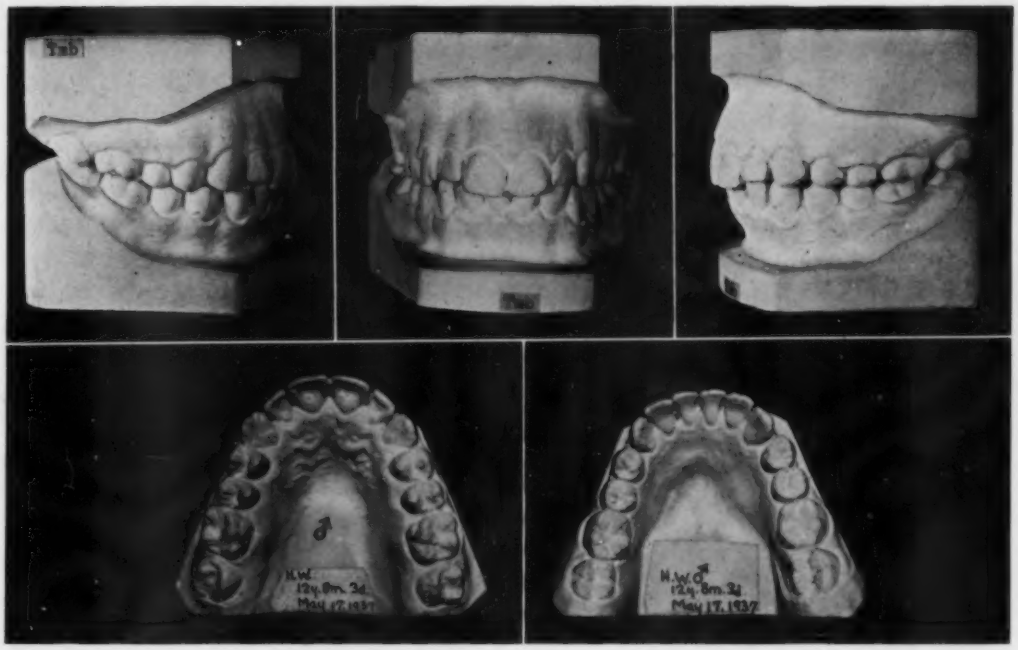

Fig. 18.—Casts of dentition of same patient as in Fig. 17, 8 months later, showing result of treatment.

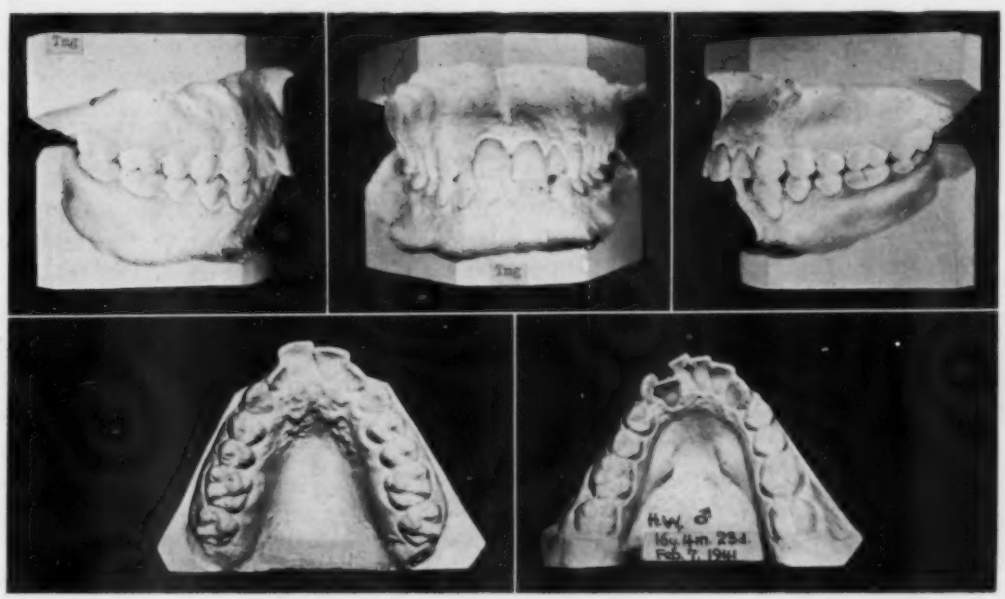

Fig. 19.—Casts of dentition of same patient as in Fig. 17, four years after retention was removed; relapse in front due to unnoticed pernicious habit.

about it, he always pinched both the upper and lower lips between his thumb and forefinger and pulled them forward. This admission sort of explained the mystery, but did not solve the problem nor salvage the wreck.

Another unusual case is illustrated in Fig. 20, showing the casts in side view of the dentition of a girl, 11 years of age; *A*, when treatment was started, *B*, when finished, and *C*, one year later. The case is in Class II, division 1. Treatment was resorted to and completed eight months later. At that time, the deciduous second molars were still present, while the permanent second molars were beginning to erupt. When the second molars begin to erupt, it is important to dispose of the deciduous second molar teeth, to permit the permanent first molars to move forward and close up the excessive space left by the deciduous teeth. This was done. But, as shown in Fig. 20, *B*, this created large spaces. To be helpful, the girl started sucking in the cheeks through the spaces.* Eventually, as the premolars began to erupt, she was biting the cheeks. And now, though the case is finished in so far as correcting the original condition is concerned, there is an open-bite to be contended with (Fig. 20, *C*).

5. *Lack of Proper Dental Collaboration.*—Angle had the idea that poor fillings are causes of malocclusion. But that was at the end of the last century. Of course, bad fillings are still with us even now, but they are not so frequently encountered as in the "gay nineties." It is the inlay which made the great change. The trouble is that some of the best inlays, though invariably good fillings, are not always good tooth restorations. Sometimes they not only distort the form of the teeth, but also in cases of malocclusion prevent the establishment of normal occlusion. The cast shown in Fig. 21 has some points of interest. Note, for example, the difference in outline, form, and contour between the permanent lower first molar on the right side and that on the left side. The molar on the right side has a large disto-occlusal inlay, the one on the left has not. The trouble is that the inlay not only fills the cavity of the tooth, but it also fills in the sulcus between the slopes of the buccal and lingual cusps. Moreover, the inlay being extended too far distally and raised occlusally, it lengthens the mesiodistal dimension and narrows the distance between the cusps. The trouble is that inlays are finished according to the "bite" obtained when the impression is taken without the necessary attention to the peculiarities of the cusps of the opposing tooth with which the one getting the inlay is in occlusion. Under perfectly natural conditions, lingual cusps of upper molars, like the cusps of any tooth, are variable in size. Very often, also, the distolingual cusp in particular is exceedingly small. Under such circumstances, the distolingual cusp of the upper molar fails to make occlusal contact with the lower molar. The "bite" taken for the inlay, after the cavity is prepared, does not reveal the actual occlusal situation. When the inlay is finished according to the "bite," the part of it making occlusal contact with the distolingual cusp is, as shown in this case, on a higher level than that of the mesiolingual cusp, i.e., it makes an inclined plane of the occlusal surface of the lower tooth. This sort of restoration is all right; but as this case happens to be in distal occlusion, it becomes

*I subsequently learned that she had been told she looked like hollow-cheeked Carole Lombard.

impossible to move the opposing teeth into normal occlusion. If an orthodontist tries to point out such an error to the general practitioner, he is in a tough spot. When one dares, as I did in this case, he loses the patient. Others not taking such risks are at a disadvantage and can do nothing about it. Or can they?

Of course, I understand thoroughly that as an orthodontist I, too, am treading on thin dental ice. But while at it, I might also suggest that it often happens too that the distolingual cusps of upper molars may be entirely absent. An inlay made for the lower molar should, under such circumstances, be made just to fill the cavity and restore the proper anatomic details of the tooth crown, heeding the occlusion of the mesiolingual cusp of the opposing tooth. The inlay problem concerned with the small upper distolingual cusp is to be solved in the same way. Make the tooth restoration occlude with the mesiolingual cusp and forget the occlusal contact of the diminished distolingual cusp. In the restoration of tooth form and pattern, the best example to follow is to copy exactly the mate on the other side, of course, in mirror image.

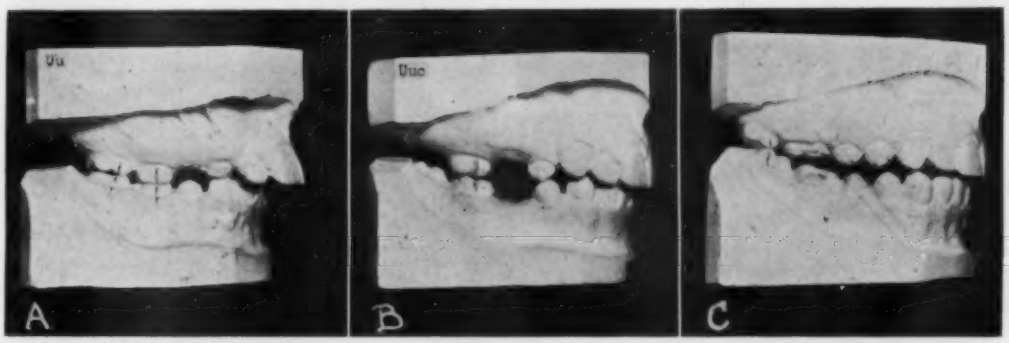

Fig. 20.—Side views of casts of dentition of girl with Class II, division 1 malocclusion, showing: *A*, when treatment was begun, *B*, at completion of treatment when habit of cheek biting was begun; *C*, the subsequent effect of the biting habit on the occlusion of the teeth.

Fig. 21.—Occlusal view of cast of lower dentition, showing difference in form of lower right first molar with large gold inlay from that on left side without inlay. Also note lapping of distomarginal ridge of inlay over mesial marginal ridge of second molar erupting behind.

Another point of orthodontic significance, regarding extensive tooth restorations, is that concerned with the adjacent teeth before they have erupted. Those "*plus contour*" restorations of years gone by should be changed to *proper*

anatomic contour, if troublesome consequences are to be avoided. Note, for example, Fig. 22. The X-ray in this figure shows how effectively the upper right second premolar is prevented from erupting by a double "plus contour" inlay in the first premolar. In this figure, *B* shows the right side of the casts with the partially impacted second premolar, and C shows the right side after the tooth took its proper place. This illustration was furnished me through the kindness of Dr. M. A. Munblatt. Just grinding off the unnecessary "plus" portion of the inlay did the job.[10] There was no need for other orthodontic measures. This, of course, is an extreme case but not unusual. In less striking forms, "plus contours" interfere in many other ways. Thus, erupting teeth may not only be prevented from taking their proper position, but also from making the proper occlusal contact. Fig. 23 shows the cast of an upper dental arch in which the inlays in the upper first molars interfere with the eruption of the second premolar on the left side and with its occlusion on the right side.

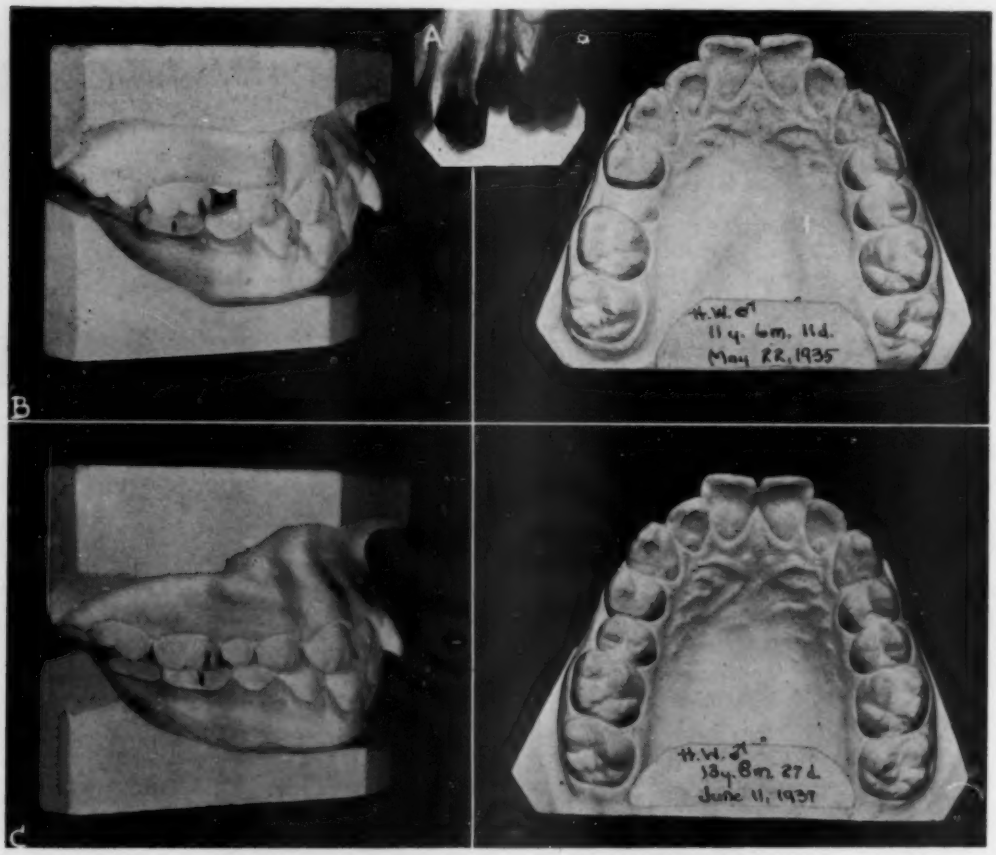

Fig. 22.—Casts and x-ray of upper teeth, showing partly impacted upper right second premolar. *A*, X-ray showing the inlay in the first premolar preventing the second from erupting; *B* and *C*, the casts before and after the extension on the inlay was ground off. (Munblatt, M. A.: Am. J. Orthodontics and Oral Surg. 28: 230, 1942).

Note, for example, how the mesial marginal ridge of the inlay in the upper right first molar tooth, being too prominent and on too high a level, laps over the distal marginal ridge of the second premolar. In Fig. 21, it should also be observed

how effectively the distal marginal ridge of the inlay in the lower right first molar is lapping over the mesial marginal ridge of the erupting second molar behind. No comments are necessary to make the trouble in question any plainer than is shown in the actual illustrations.

Fig. 23.—Occlusal view of cast of upper dentition, showing mesial marginal ridges of upper first molar inlays preventing eruption of second premolar on the left side and interfering with occlusion on the right side.

6. *Presence of Pathological Conditions.*—It is, of course, clear that in the discussion so far, no disease processes were taken into account. Yet, there were sufficient conditions mentioned to warrant caution in orthodontic procedure and even sufficient ground to refrain from it. It is my opinion that *no pathological condition, regardless of how slight or insignificant, whether it is general or local, can be considered favorable to orthodontic procedure.* Nutritional disturbances, too, are serious handicaps, as are vitamin deficiency, allergic idiosynerasy, and endocrine imbalance. All of these anomalies should be taken into account and looked at with apprehension if trouble is to be avoided. Frankly admitted then, the problem of orthodontia, as influenced by just such elementary and fundamental conditions as cited and discussed, is puzzling enough. It becomes confusing when, besides this, the perplexing problem of pathology is added. It is not uncommon among orthodontists to blame failures of achievement on obscure pathological, nutritional, and endocrine conditions. It is my opinion that, if indications at all point to such complications, they should be made certain before orthodontic procedures are initiated. All that can be expected of tissue regeneration is to regain the losses sustained by mechanical trauma alone. When pathological conditions are added onto traumatized tissues, the damage may be too great for regeneration to make up for it. *It is far better to point out suspicious consequences as a warning before injury is done, than use them as an alibi after it cannot be helped.*

SUMMARY

To summarize, it might be pointed out:

1. That the unfavorable conditions dealt with are just inadequacies which might be considered as subjective, objective, or a combination of both.

2. That these inadequacies are apparently not taken seriously enough, or there would not be so much evidence of their prevalence.

3. That these inadequacies are *not* insuperable, but must be recognized to be overcome.

4. That, if these unfavorable conditions are more fully accounted for at the beginning of orthodontic procedure, there will be less ground left for disappointment at the end.

The inescapable conclusion is that it is of far more advantage to be cautious, wary, and apprehensive before plunging headlong into the mists of orthodontic adventure than to discover later that it is detrimental and was not advisable. I should hold out the admonition that attempts in orthodontic procedure, to be fully justified, depend entirely upon a clear understanding, not only of the goal to be achieved, but also of the impediments interfering with achieving it. All obstacles in the way of achievement are costly if overlooked at the beginning, and the cost of orthodontic procedure is measured not so much by the price paid as by the gains made.

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PERSONAL RECOLLECTIONS OF MILO HELLMAN

JOHN V. MERSHON, D.D.S., SC.D., PHILADELPHIA, PA.

IT WAS on a Monday morning, early in September, 1908, that a group of twelve men met in a hotel room on the corner of Seventy-second Street and Broadway, New York City. It was the opening of the eighth session of the Angle School. We were all embryo orthodontists. It was the beginning of new careers and the making of new friendships. That was my first contact with Milo Hellman—the beginning of a friendship which was always active until his untimely death.

Milo, Fred Noyes, and I seemed to single out one another. I feel that Noyes' teaching at that time helped immeasurably in directing Dr. Hellman's intellect and energies in the direction which they subsequently took. Dr. Noyes lectured inspiringly, beginning with the embryologic cell and going, step by step, through all development up to the tissues in a fully matured human being.

Another who had a lasting influence on Milo Hellman's career was Raymond C. Osburn. He taught anthropology at the Angle School, and it was through him that Dr. Hellman started in the direction which was to bring him lasting fame.

Dr. Hellman could have been, and was, outstanding in many varied fields. He was a professional musician of high standing when his interest in anthropology led him to change his life's work.

It was this interest in anthropology which led him to embark on his exhaustive research into causes of malocclusion and orthodontic procedures. He realized that perfection does not exist. He promoted the idea that orthodontists are not just "tooth-pushers," that they are working with the most amazing thing there is—human growth. He made clear the dangers of extremes in treatment.

All his research would have been of value had he simply done it and had the results published. But that was not Dr. Hellman's concept of what a scientist owed his confreres and humanity. As a result, he gave untiringly of his time and knowledge in making his discoveries known. He taught in universities, wrote for magazines, lectured at professional meetings, and did all anyone could to help others. There was seldom a meeting of the Eastern Association of Graduates of the Angle School of Orthodontia at which Dr. Hellman did not have something new to contribute.

Dr. Hellman was honored by many institutions and societies, but we remember him not only for his scientific knowledge and the many honors he merited, but also for his genial personality and sterling character. He was truly

Presented before the Northeastern Society of Orthodontists, Nov. 11, 1947, as part of the Memorial Program in Honor of Milo Hellman, D.D.S., Sc.D., New York, N. Y.

a servant of mankind. It was this zest for knowledge and zeal in disseminating it which kept him active until the time of his death. He was never called on to perform any service that he did not cheerfully do it.

Nothing we can say here can adequately express our devotion to Dr. Hellman or our everlasting gratitude for what he gave all of us and through us, humanity. The finest memorial we can raise to him, the one I know he would prize most highly, is a dedication, in our hearts, to use the knowledge he left us, and the example he showed us, for the betterment of those we serve.

May I paraphrase the immortal words of Abraham Lincoln: The world will little note or long remember what we say here, but it can never forget what Milo Hellman did.

1520 Spruce Street

MILO HELLMAN'S STUDIES ON THE EVOLUTION OF THE TEETH, JAWS, AND FACE

WILLIAM K. GREGORY, SC.D., PH.D., NEW YORK, N. Y.

THROUGH his training as a member of a famous orchestra, Milo Hellman knew well that it is necessary both to consider every musical composition as a whole and to study each theme or passage as a part of that whole. Perhaps he did not at first clearly grasp this far-reaching principle or formulate it in the same terms when applied to his scientific and practical studies; but his subsequent history shows that, even after prolonged investigation of some limited theme, such as the varying tempo of development and replacement of the teeth in children, he never lost sight of the whole field.

Unfortunately, I do not know the earlier sources either of his feeling for patterns as a whole or of his delight in producing technically beautiful and lasting results both in his patients and in his investigations. But he evidently appreciated Dr. Angle's ideal of gradually overcoming irregularity and disorder with reasoned order and beauty.

From Dr. Angle he learned also the central position in orthodontics of the concept of normal occlusion and its opposite, malocclusion. At the Angle School of Orthodontia, from the lectures of Dr. Raymond C. Osburn, a distinguished student of Professor Henry Fairfield Osborn, Hellman first learned that man's skull, teeth, jaws, and face are only the present terms in an evolutionary sequence that stretches backward into aeons of geologic time. Later, from Professor Franz Boas of Columbia University, he learned various effective techniques in analyzing measurements and in constructing effective diagrams. From Professor T. H. Morgan he learned at once the clarity of Mendelian principles and the complexity of their operation.

By a careful apportionment of his time, he was able for many years to devote one day a week to his studies, not to mention holidays and evenings, but every day he was amassing valuable observations in his profession as orthodontist. As time went on, his investments in study and patient investigation yielded cumulative results. All this was reflected in his numerous papers, which were read before dental and orthodontic associations and were fortunately recorded in their periodical publications.

All Hellman's studies in the field of genetics, anthropology, and evolution were originally motivated by his interest in orthodontics. Thus, through the years he was always striving to learn more about the vast and age-long complex of interacting causes and conditions which had produced the particular cases of malocclusion and malposition with which his patients confronted him. To him,

Read before the Northeastern Society of Orthodontists as part of the Memorial Program in Honor of Milo Hellman, Nov. 11, 1947.

his evergrowing knowledge of the general biologic, evolutional background against which he viewed each orthodontic problem was absolutely essential for the successful diagnosis, treatment, and prognosis of that patient.

Fortunately, he was never satisfied with a superficial acquaintance with facts; he had a lively desire to find out how facts were related to each other in their causal and temporal series. He spared no pains, first, to search the literature in order to trace the history of the problem which he was investigating; second, he strove to amass sufficient correct evidence; third, to discover statistically reliable correlations, as between age and stature in different economic classes.

Some scientists are not really enthusiastic about either facts or generalities which they themselves have not discovered. Hellman, on the contrary, was always grateful to those who had opened the pathways which he hoped to widen and push farther. This faculty of understanding and appreciation, which was part of his effort to take the long view and see patterns as wholes, helped to make him a willing, enthusiastic, and unselfish collaborator. Thus, he was always welcomed in the various institutions, libraries, laboratories, department conferences, and formal meetings, in which he and his colleagues analyzed, synthetized, and discussed the data of their science.

The story of Hellman's career as a scientist is written in the long array of his nearly one hundred published papers. Other speakers will deal with his work in the fields of physical anthropology and in orthodontics proper, but I shall attempt to indicate how Milo Hellman's studies led him to develop mutually advantageous cooperation with others whose main interests were in the field of comparative anatomy and evolution.

Since human teeth are rooted in bony jaws, it was fortunate that almost at the beginning of Hellman's career as a scientist, Dr. Angle assigned to him the by no means easy topic of summarizing what bony tissue is, especially its reactions to outside mechanical forces. Hellman's first published paper entitled "Bone Tissue, Its Growth and Development. A Résumé" (1912) was an excellent summary of earlier and contemporary literature in this field. It was followed in 1914 by a paper summarizing the experimental work of Dr. Oppenheim of Vienna, who had used orthodontic methods to push the teeth of macaques into new position, and had later studied microscopic sections of their jawbones, showing the response of the bony tissues to the traumatic effects of the appliances.

Hellman early came to the American Museum of Natural History, New York, as a great center for the study of evolution, both of the lower vertebrates and man. He was introduced at the Museum by Dr. Raymond C. Osburn, and soon began his studies in the department of anthropology, then under Professor Boas and Dr. Clark Wissler.

At that time and ever since then, the successive stages of evolution of the teeth, jaws, and bony face, from fish to man, were of outstanding interest in the Museum. Professors Cope and Osborn had long since made their brilliant discoveries and generalizations, and Osborn's system of naming the main cusps of the mammalian molar crowns was to vertebrate paleontology about what

Angle's nomenclature of malocclusion was to orthodontics. Both systems had aroused healthy skepticism, and were later shown to be in need of minor corrections and emendations; but, in the active decades that followed, the Theory of Tritubercuiy and Angle's Classification of Malocclusion withstood well not only the attacks of unfriendly critics, but the discovery of countless new facts and the great widening of their respective backgrounds.

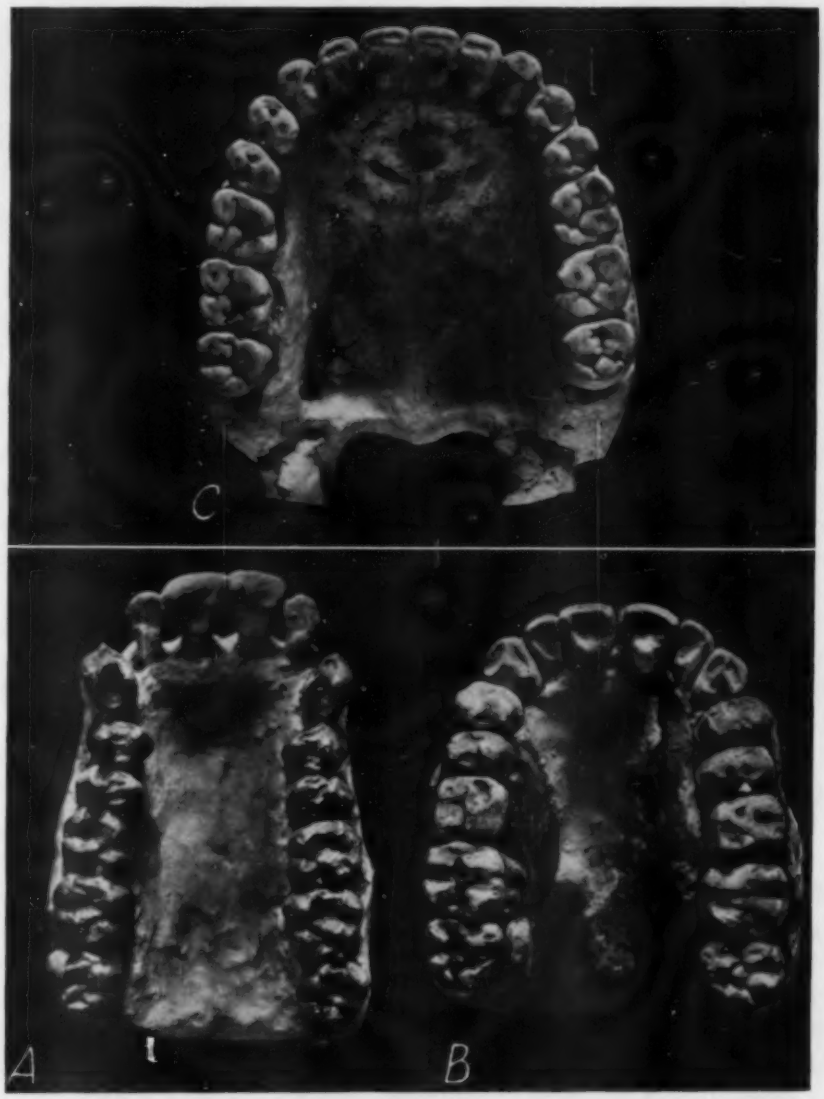

Fig. 1.—Models of upper dental arches: *A, Sivapithecus (Dryopithecus) indicus* o (Pilgrim); *B, Australopithecus transvaalensis* Broom; *C, Homo sapiens heidelbergensis. A* and *B,* by Milo Hellman; *C,* by J. H. McGregor. (First published in *Nature.*)

At the time that Hellman first came to the Museum, I was conducting in my laboratory-classroom there two Columbia University graduate courses, one on the evolution of fossil and recent vertebrates from the earliest fishes up to reptiles, birds, and the mammal-like reptiles, the other on the mammals. Hell-

man accepted my invitation to "sit in" on both these courses. This he did to our mutual profit and satisfaction, and that, too, over many years, for he was never able to attend these courses continuously from beginning to end in one year. Among the results of our association, we prepared together some sixteen scientific papers, beginning in 1926 and ending in 1945.

The earlier results of our cooperation are recorded in his articles, "The Significance of Normal Occlusion" (1913) and "Dimension versus Form in Teeth and Its Bearing on the Form of the Dental Arch." Here Hellman showed that the occlusal relations of the upper and lower molars in man in the lateral aspect had assumed new and distinctly human characteristics; but that in the lingual aspect the protocone of each upper molar fitted into the talonid fossa of a lower molar exactly as it does in most other mammals, both fossil and recent. Hence, he took this well-established fact in paleontology and made it the starting point of his later studies on occlusion.

Knowing the intricacy and complexity of heredity, development, and growth in the individual, he resolutely opposed what he regarded as the oversimplification of orthodontic practice which had been proposed by advocates of what he called the "engineering school" of orthodontics. Some had advanced the view that in an ideally perfect dentition there was such a high correlation between the width of the upper central incisor and the dimensions of the dental arch that a deficient dental arch could be reconstructed on paper before beginning treatment by the application of engineering principles and formulas, provided only that the mesiodistal width of the upper central incisor be given. As part of his attack on this claim, Hellman sought to ascertain whether, under natural conditions, there was indeed a close correlation between the mesiodistal width of the central incisor and the mesiodistal length of the third molar. At the invitation of Dr. Gerrit S. Miller of the United States National Museum, he made careful measurements of the dimensions of the individual teeth and on the forms of the upper and lower dental arches in a collection of fifty orang skulls. From this material he showed (1918): (1) that the upper and lower dental arches in the orang could be classified under five types, to which he gave appropriate names; (2) that any given type of dental arch in the palate may be associated with any given type of lower arch; yet that certain associations were more frequent than others; (3) that in the series studied there was no correlation between the width of the upper central incisor and the size or shape of the dental arch; (4) finally, that in the orang the type of the dental arch was dependent not upon the size of individual teeth, but upon the form and positions of the teeth. Here, again, the immediate objective of Hellman's investigation was the solution of a problem in orthodontics; but its results were of value and interest in paleontology. Moreover, they helped to prepare him for his later work in restoring the dental arches of fossil man apes and ape men.

Hellman's sustained interest in my studies in dental evolution from the earliest fossil stages onward was an incentive for further efforts on my part. Between 1904 and 1907, I had been privileged to assist Professor Henry Fairfield Osborn in the preparation of his book, *The Evolution of the Mammalian Molar*

Teeth to and From the Triangular Type, and, thanks to Hellman's suggestion, I was from time to time invited to read papers before orthodontic and dental societies. The results were set forth in several papers and more fully in my book, *The Origin and Evolution of the Human Dentition*. I was, therefore, happy to be able to invite Hellman to be my coauthor in studies on several new jaws of fossil anthropoid apes which Barnum Brown had discovered in the Siwalik hills of India. Our results were published in 1926 under the title, "The Dentition of *Dryopithecus* and the Origin of Man." At that time, the Museum lacked funds for the publication of this extensively illustrated paper, but, through the generous initiative of Dr. Eby and Dr. Young, forty-three men, mostly orthodontists, some of whom are here today, subscribed to the Museum

Fig. 2.—Hellman's second, revised model of *Australopithecus*. (Courtesy of *Am. J. Phys. Anthropol.*)

publication fund, and thus made possible the printing and distribution of our monograph. Hellman took most of the new measurements on the material and added many others from his own notebooks, in which he had systematically recorded hundreds of measurements in anthropoid and human teeth which he had made in various museums. Together we checked every statement and we were equally responsible for all parts of the text. In 1916, I had used the phrase "*Dryopithecus* pattern" to designate a particular arrangement of the lower molar cusps and grooves in anthropoid apes, and had shown that clear traces of this pattern appear on the first and second lower molars of many human jaws. In our paper, "The Dentition of *Dryopithecus* . . .," thanks to the possession of good material, we were able to set forth much additional evi-

dence that the "*Dryopithecus* pattern" of the lower molar was really fundamental in man as well as in the apes.

The very thought of man's being a moderately near cousin of the surviving anthropoid apes was unendurable to some scientists both then and now. Thus, our showing of the fundamental resemblances in the dentition between apes and primitive men failed to convince certain scientists, who contrasted the tusk-like canines of male anthropoids with the relatively small canines of even the earliest known races of men; they also regarded the compressed anterior lower premolar of male anthropoids as evidence that the anthropoid stock was remote from man, in whom this tooth is more or less bicuspid.

In continuation of our work on *Dryopithecus* (1928), Hellman made a systematic survey of hundreds of human jaws belonging to the principal human races. He showed that the *Dryopithecus* pattern occurs on the first, second, and third lower molars in descending percentage; that it is subject to progressive simplification, from five cusps to four cusps, in varying percentages in different races, the most conservative being the Australian aboriginals, the most simplified, the white. This striking example of evolution by simplification should be of interest to those who forget that evolution does not always pass from the simple to the complex along orthogenetic lines, or that a marked advance in certain features frequently entails recession in others.

In 1917, Dr. Stewart Smith of Australia brought to us in the Museum the cast of a fossilized human skull which had been found at Talgai, in Queensland, Australia. In his memoir on this skull, Dr. Smith had restored the upper dental arch as being rather of the anthropoid type, with nearly parallel sides and laterally jutting canines. From a close study of this cast and of large photographs, Hellman saw that one side of the palatal arch was less distorted than the other. By means of duplicate casts, he cut the unrestored palate into pieces, using the main cracks and fissures shown in the original casts and in the photographs. He was then able to reassemble the pieces in order to correct the *post-mortem* displacements. He also used the pressure scars on certain teeth to put the molars into correct alignment. When his pieces were thus fitted together, they showed a rounded arch not unlike those of Australian aboriginals, but quite unlike the straight-sided palatal arches of recent apes (Hellman, 1934c).

Some years later, George L. Lewis of Yale University collected more anthropoid jaws and teeth in India while on an expedition sent by the Carnegie Institution, Cambridge and Yale Universities. This material was studied by Gregory, Hellman, and Lewis, whose report was published by the Carnegie Institution in 1938. Here it was shown that these extinct Siwalik Indian anthropoids varied widely in the size and proportions of their lower molar teeth, some third molars being relatively very long and narrow, others, short and wide; that while some had tusklike canines and presumably were males, others had smaller and shorter-crowned canines with basal swellings and well-developed internal cingulum, and that the several parts of these canines were comparable and apparently homologous with essentially similar but less-developed features in some human canines. Hellman's intimate knowledge of the dental arches and occlusal relations in anthropoids and man and his skill in modeling made it possible for him to model certain teeth which were missing on one side of one of the

Siwalik specimens, and then to assemble the upper teeth in a dental arch which occluded quite well with the known lower dental arch of another closely allied specimen.

At one point of our collaboration, I made what proved afterward to be a serious mistake in identification. For, after making numerous measurements and comparisons in a certain badly eroded fossil tooth from the Upper Miocene of Nebraska, we showed that in form, in measurements, and in internal structure it could be nearly matched with a much-worn upper third molar of a certain chimpanzee. I also found that it differed from many other types of mammalian molars with which I had compared it. But, several years later, I collected more fossil teeth in the Nebraska quarry that had yielded the "mystery tooth." The new fossils convinced me that the much-publicized supposed molar tooth of an American anthropoid could be more closely matched with an equally worn upper anterior premolar from the jaws of an extinct genus of the peccary family which was relatively far more abundant in that quarry. This mistake was definitely not Hellman's fault; it was my misfortune to mistake this much-worn tooth for a molar, and it was even very unlike the premolars of the many fossil mammals with which I had compared it.

In 1925, Hellman, in collaboration with his friend, Louis R. Sullivan, published the description of a fossilized human skull which had been discovered in the Punin ash beds near Riombamba, Ecuador. Under Hellman's supervision, the much-broken skull was carefully and satisfactorily reconstructed in the laboratory of the American Museum Department of Anthropology. Strange to say, in all its measurements and visible characters this skull, like the Lagoa-Santa Brazilian type and several others, differed widely from American Indian skulls and closely resembled those from Australia or Melanesia. The authors write: "We wish to emphasize particularly the point that in claiming this calvarium is australoid, we have in mind a basic racial relationship and do not believe that it necessarily represents migration from Australia or Melanesia. . . ." Subsequent similar discoveries in North and South America by other anthropologists indicate that this australoid type has turned up again and again in the midst of more normal-looking Indian skulls.

In 1937, we again collaborated in the preparation of two papers dealing with the "Evidence of the Dentition on the Origin of Man" at an International Symposium in the Academy of Natural Sciences of Philadelphia. We also collaborated in the delivery of papers on the evolution of the jaws and teeth at the Bicentennial Celebration of the University of Pennsylvania in 1940.

In the course of our work, we often experienced the need of some standard measurement which could be taken in every kind of mammalian skull and which could be used as a unit, on a percentage basis, for measuring the very variable proportions of the different parts of the cranium, face, jaws, and teeth. We finally chose as our unit the basal length of the cranium from the anterior wall of the olfactory fossa to the occipital condyle; then, after drawing up a list of proportional measurements in terms of this unit, we applied the system to the study of a collection of skulls that represented most of the genera of the highly diversified aeluroid carnivores, that is, of the civets of Africa and Madagascar, the mongooses of Asia and Africa and their numerous relatives, and, also, the

hyenas and cats, all of which belong to the same superfamily. It was our intention to construct graphs which would give the general pattern of the skull in side view, showing the relative proportions of the different parts in related species and genera. But, while we never actually did this, the proportional measurements we took on this system were of constant use in our paper "On the Evolution and Major Classification of the Civets (Viverridae) and Allied Fossil and Recent Carnivora: A Phylogenetic Study of the Skull and Dentition," which was published in 1939.

His earlier studies led Hellman to the construction of his illuminating graphs for contrasting the relations of the jaw to the skull and upper face in different human types.

In 1938, we received a cordial invitation from Dr. Robert Broom of Pretoria, South Africa, to make a journey to South Africa to study and report upon the jaws and teeth of his *Plesianthropus*, an extinct man ape or ape man. Professor Raymond Dart of Johannesburg, the describer of *Australopithecus africanus*, also invited us to study his type, a beautifully preserved child-ape skull with the deciduous teeth and first permanent molars in place. Accordingly, in May, 1938, Hellman and I, with Mrs. Gregory, made the long journey to South Africa, where we were most cordially welcomed by his orthodontic colleagues and by my friends, the paleontologists. At Pretoria, Dr. Broom gave us every opportunity to study his material, and Hellman took numerous measurements and made many casts of the teeth and jaws. At Johannesburg, Professor Dart gave us equal facilities in studying his *Australopithecus*. After our return, Hellman made his reconstructions of the upper and lower dental arches of *Plesianthropus*, and later the first and second trial models of the skull of that form. We also prepared a detailed report on our observations, measurements, and conclusions, which was published in *Annals of the Transvaal Museum* in 1940. In general, we fully endorsed the conclusions of Dart and Broom that these Australopithecines were neither apes nor men, but that they combined anthropoid features in the skull and brain cast with some almost human features in the teeth.

It was our intention to write a book together on the evolution of the face from the earliest vertebrates to man, and we did, indeed, spend many absorbing days in going over the morphologic and paleontologic evidence, and in discussing numerous problems. After he had recovered from a severe illness in 1943, however, it became urgent for him to concentrate on his book on orthodontics, and for me to devote all my available time to my work on the evolution of the vertebrates, which is now near completion. Thus, our active partnership ceased, but our friendship remained unclouded until the end.

Although I sorely miss his companionship, I am content that I had the good fortune to be so long associated with him in the study of evolution. His incisive analysis of complex problems, his constructive conclusions, and his ever-broadening wisdom helped all who knew him or read his papers to see their own changing problems in more correct perspective against a shifting background. I share with his family and his other loyal friends the confident resolve that his influence in the advancement of science shall be perpetuated.

THE CONTRIBUTIONS OF MILO HELLMAN TO PHYSICAL ANTHROPOLOGY

WILTON MARION KROGMAN, PH.B., M.A., PH.D.,* PHILADELPHIA, PA.

MILO HELLMAN'S great contribution to the science of physical anthropology can be summarized in one short sentence: He took a technique that was dead and static and vitalized it into one that was alive and dynamic. By this I mean that he adapted a series of measurements originally designed for adult skulls, and applied them to the heads and faces of *living* individuals—nay, more than living, *growing* individuals! Dr. Hellman was literally a pioneer in the *practical application* of anthropometric techniques. In his hands anthropometry (more precisely craniometry) justified its birthright as a precise science. It is in keeping with his use of precise measurement that Dr. Hellman brought to orthodontia a rigorous, uncompromising attitude of scientific objectivity: classification, diagnosis, and procedure were all subservient to a thorough study and analysis of each case under observation and/or treatment. If Dr. Hellman's attitude could be reduced to a single phrase, it would be: *Know* your patient—which really means know the *growth pattern* of your patient.

In analyzing Dr. Hellman's research, it is important to note that his basic work was done on crania, largely from the American Museum of Natural History (where he was Research Associate in Physical Anthropology). Obviously, on such material it was impossible to use age-classes in terms of chronological years. He accordingly postulated a series of seven "stages of dental development," as follows (see 1927a, p. 478; 1929, p. 183; and 1940a, pp. 430-431):

> Stage I designates that period of early infancy before the completion of the deciduous dentition.
>
> Stage II designates the period of late infancy at the completion of the deciduous dentition.
>
> Stage III designates the period of childhood, when the permanent first molars are erupting or have taken their positions, in addition to which some or all of the deciduous incisors have been lost and are being replaced by their permanent successors.
>
> Stage IV designates the period of pubescence, when the second permanent molars are erupting or have taken their positions in addition to which some or all of the deciduous canines and molars are lost and are being replaced by their permanent successors.
>
> Stage V designates the period of adulthood when the third molars are erupting or have taken their position.

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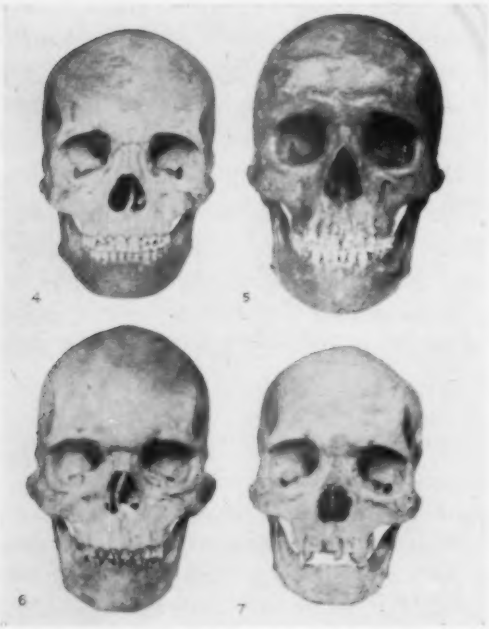
Presented before the Northeastern Society of Orthodontists, Nov. 11, 1947 as part of the Memorial Program in Honor of Milo Hellman.

Stage VI designates the period of old age when the occlusal surfaces of the molars are worn off to the extent of obliterating the pattern of grooves.

Stage VII designates the period of senility, when at least half of the crowns of the teeth are worn off, in addition to which some, most, or all of the teeth have been lost.*

A.



B.

Fig. 1.—*A* and *B*, Photographs of type skulls in Dental Stages I to VII (1926, pp. 69-70).

What Dr. Hellman was actually doing here was one of his truly significant contributions. (It was literally forced upon him, for he did not and could not know the ages of his cranial series.) He emancipated the thought of growth

*In practice, Dr. Hellman used subdivisions within each stage, especially in mixed dentitions of III and IV (See 1940a, p. 431). In 1926, he published typical photos of each stage (see pp. 69-70; also see 1929, Figs. 1 to 7, pp. 184-185). (Fig. 1, *A* and *B*.)

theorists from a slavish adherence to birthday-age, and focused upon the *real* age, the biologic (dental) age. What was originally a necessity became a tremendously important concept.

In his 1927a paper (p. 479), he offered the following stage-age equivalents, but he invariably followed his stage classification:

STAGE	NUMBER	AVERAGE AGE	STANDARD DEVIATION
I	None	----------	----------
II males and females	13	6.00 years	1.13 years
III males	85	9.98 years	1.76 years
females	89	9.80 years	1.66 years
IV males	74	14.98 years	1.76 years
females	121	14.44 years	2.00 years
V females	11	22.45 years	1.83 years

These were New York patients of Dr. Hellman.

In 1929 (see Fig. 13, p. 195, Fig. 2 of this paper), Dr. Hellman presented a diagrammatic profile of facial size, proportions, and positions in each of the seven stages. For this purpose he used prehistoric American Indians (Arizona) of both sexes.

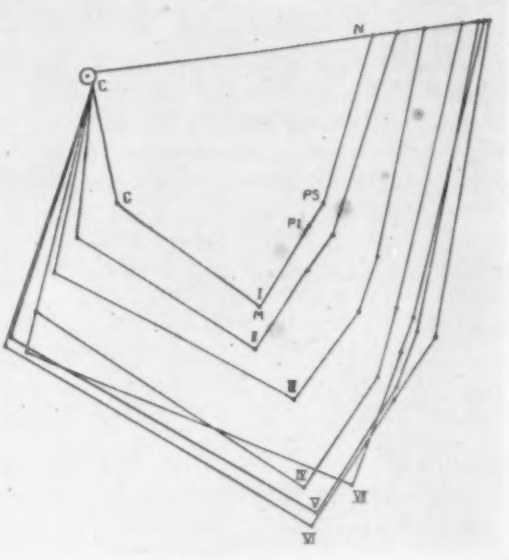


Fig. 2.—Typical facial profiles in Dental Stages I to VII (1929, Fig. 13, p. 195).

Dr. Hellman showed initiative and imagination in his use and adaptation of craniometric measurements. From the very beginning, he accepted the fact that the growth of the face and its general craniofacial relationship must be measured in three dimensions: height, breadth, and depth (or length). The measurements he employed are set forth in several of his papers.*

I have chosen his 1927a and 1927b papers as typical.†

*See: 1927a, pp. 481-483; 1927b, p. 922; 1929. Fig. 8, p. 186, Fig. 10, p. 191; 1931a, p. 136, Fig. 20, p. 137, Fig. 21, p. 138; 1933a, pp. 1121-1122.

†I am taking the liberty of editing the definitions a bit, in the interests of greater clarity and / or precision. This will be shown by the use of brackets, thus: [ ]. The parentheses ( ) are his.

A.—Measurements of Height of Face:

(a) Total face height, from the [midsagittal] point where the nasal bones [internasal suture] articulate [intersect] with the frontal bone [nasofrontal suture] [nasion] to the lower border of the mandible [in the midsagittal plane] (menton) [gnathion].

(b) Upper face height, from nasion [in the midsagittal plane] to the lowest interalveolar point of the bony septum between the upper central incisors (upper alveolar point).

(c) Lower face height (symphysial height) [in the midsagittal plane] from highest point of interalveolar septum between the lower central incisors (lower alveolar point) to the menton [gnathion].

(d) Dental height or interalveolar distance [the midsagittal distance] from the lowest point of interalveolar septum between the upper central incisors to highest point of interalveolar septum between lower central incisors.

(e) Anterior nasal height [midsagittal distance] from nasion to the lowest point of the anterior margin of the floor [lower margin] of the nose [nasal aperture] [nasospinale].

(f) Posterior nares height [midsagittal distance] from base of vomer to the posterior margin of the palatal process of the palate bone.

(g) Subnasal height [midsagittal distance], from anterior margin of the floor of the nose [nasal aperture] [nasospinale] to the upper interalveolar point.

(h) Palate height, from a line at the top of the interalveolar septum between second and third molars on both sides to the highest point of the palate [transverse palatal arch] in the median line. (For this measurement a special instrument had to be devised because this point had to be ascertained from three planes—anteroposteriorly, transversely, and vertically.)

(i) Mandibular height, from the point of the interalveolar septum between first and second molars to the lower border of body of mandible held in a horizontal plane.

(j) Ramus height (measured with a Reserve goniometer)—

(1) Condylar height, from the angle of the jaw (gonion) to highest point of condyle.

(2) Coronoid height, from the gonion to the tip of the coronoid process.

(k) Sigmoid notch depth, from a line touching the highest points of the condyle and coronoid process to the deepest point in the curve of the notch.

B.—Measurements of Width of Face:

(a) Interorbital, between the points of articulation of frontal, maxillary, and lacrymal bones [dacryon].

(b) Bimalar, between the maxillo malar suture at the lowest point [zygomaxillare inferius].

(c) Bizygomatic, between the zygomata at their widest spread [zygion].

(d) Nasal width, between the lateral margins of the nasal aperture at their widest points.

(e) Posterior nares, between the posterior margins of the internal pterygoid plates about one-third above the palate.

(f) Bicanine (minimum alveolar arch width), (1) between the most prominent facial points of the canine alveoli, in the maxilla, and (2) at the most prominent point between the canine and first premolar in the mandible.

(g) Minimum palate, between the palatal margins of canine alveoli.
(h) Maximum palate, between the alveolar margin distally to the second molar.
(i) Maximum upper alveolar arch width, between the widest spread on the buccal side of the alveolar process.
(j) Maximum lower alveolar arch width, same as above.
(k) Condylar, between the external extremities of the condyles.
(l) Gonial, between the angles of the mandible.

C.—Measurements of Depth of Face:*

(a) Total palate depth, from anterior marging of anterior palatine fossa to a transverse line on the palate plate of palate bone indicating the nearest points of the posterior border.
(b) Anterior palate depth of maxilla from the same anterior point to the transverse suture of the palatal processes of the maxilla and the palate bones.
(c) Posterior palate depth, the width of the palate process of the palate bone.
(d) Upper alveolar arch, from the labial surfaces of the alveoli of upper central incisors (prosthion superior) to a transverse line behind the last molars [M3].
(e) Lower alveolar arch, same as above.
(f) Total mandibular depth, (1) Occlusal, from labial surface of alveolar process of central incisor (prosthion inferior) to posterior margin of ramus in the same plane. (2) Basal, from [midsagittal] anterior most prominent point on the chin [progonion] to the gonion.

D.—Measurements of Angles:

(a) Facial angle [with the skull in the Frankfort horizontal] [taken either with an "Ansteck goniometer" or in a Reserve craniostat], the points of the calipers [or craniostat] being placed at the nasion and upper prosthion.
(b) Alveolar angle, taken the same way, the points of the calipers [or craniostat] being separated 1 cm. and placed on the facial surface of the alveoli of one of the upper central incisors.
(c) Gonial angle, taken with the goniometer [angle formed by lines tangential to lower margin of corpus and posterior margin of ascending ramus].
(d) Mental angle, taken the same way as the alveolar angle—the mandible in this instance being placed on the horizontal base; the points of the caliper being placed on the most prominent point of the chin [pogonion] and below the alveolar process in the median [midsagittal] plane.

The foregoing measurements may be tabulated as shown on the following page (1927b, p. 922); (see also 1939, p. 936).

The measurements of "position" are those which later on were included as depth or length. Dr. Hellman took them with a Reserve headspanner, which was originally designed for but one measurement, viz., auricular height (from porion to apex where the skull or head is in the Frankfort horizontal). Dr. Hellman used the headspanner to take a series of midsagittal points which

*These are really anteroposterior dimensions which can reasonably be termed lengths, also. Later, Dr. Hellman used the term "depth" to refer to projected radial midline dimensions from the external auditory meatus.

MEASUREMENTS

HEIGHT	WIDTH	DEPTH	ANGLES	POSITION
Total face	Bizygomatic	Total palate	Facial	Aur. Nasion
Upper face	Bimalar	Ant. Palate	Alveolar, Upper	Aur. Pros. Sup.
Lower face	Bicanine (upper)	Post. Palate	Gonial	Aur. Pros. Inf.
Dental	Bicanine (lower)	Alveolo-Ramus	Mental	Aur. Menton
Nasal	Max. alv. arch (upper)	Pre. Ramus	Canine	
Subnasal	Max. alv. arch (lower)	Ramus		
Palate	Nasal	Basal (Mandible)		
Post. nares	Post. nares	Alv. Arch (upper)		
M. region (of mandible)	Interorbital	Alv. Arch (lower)		
Condylar	Palate Maximum	Cond. Cor. Dist.		
Coronoid	Palate Minimum			
Sig. notch	Bicondylar			
	Bigonial			

were, in reality, a series of radial projections in the midline from a biporionic plane or axis. As time went on, he added more points and measurements of "position": from what he called *auriculo* to nasion, subnasal, prosthion, upper alveolar point, incision (the edge of upper central incisors), infradental, pogonion, menton or gnathion, and gonion.

It is not quite clear just what Dr. Hellman meant by *auriculo*. It is certain that he did not use either auriculare or porion, although, strictly speaking, the use of a headspanner presupposes porion as the meatal focal point. From Fig. 12, *C*, p. 702, (1941b), it seems that he quite arbitrarily used the *center* of the bony external auditory meatus as the point from which he measured auriculo-nasion, auriculo-menton, and so on. In Figs. 12, *A* and *B*, p. 702 (1941b), he illustrated the facial height and width measurements on the skull.* (Fig. 3.)

Dr. Hellman used his measurements not only to get an arithmetic idea of size and proportion, but, much more important to him, to achieve a *graphic* portrayal of the face and its size-proportion relationships. In Fig. 26, p. 143 (1931a) (Fig. 4 of this paper), there is shown a modified "profile." Here the face is shown as a rough triangle, with radial dimensions from auriculo to nasion, the upper alveolar point, the lower alveolar point, and menton. In this illustration, the facial profiles are those of girls with Class I malocclusion, in Stages III (*A*, *B*, and *C*) and IV (*A*).

The "profiles" made graphic the essential faciodental relationships in the several classes and divisions of malocclusion. In Fig. 6, p. 934, Fig. 7, p. 934, and Fig. 9, p. 937 (1927b), the face is shown as a quadrilateral, with dimensions from auriculo to the anterior profile and to gonion, and condylar relationships in addition. Fig. 6 shows a normal profile compared with one in Class II, Division 1, and one in Class III. Fig. 7 shows varying types of Class II, Division 1, malocclusion, while Fig. 9 does the same for Class III. (Figs. 5, 6, and 7 of this paper.)

The graphic use of measurements served Dr. Hellman four major purposes: (1) The profiles served to contrast the faciodental relationships of a

*See also Fig. 2,*A*, *B*, and *C*, p. 935 (1939).

malocclueded dentition *with the normal;* (2) the profiles served to emphasize variable faciodental relationships *within* a single class (and its division); (3) the profiles served to delineate the *growth achieved during treatment* (or observation); (4) the profiles served to differentiate between the *changes* wrought

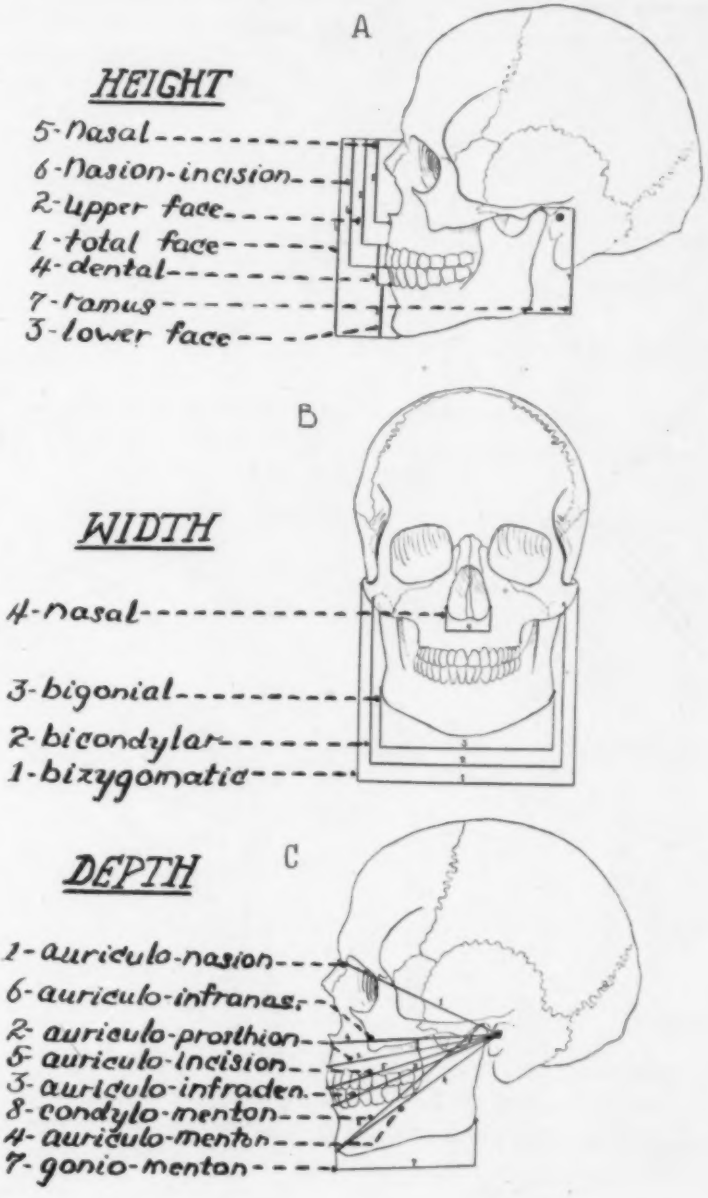


Fig. 3.—Schema of craniofacial measurements (1941b, Fig. 12, *A*, *B*, and *C*, page 701).

by growth and those possibly due to orthodontic therapy. Contrast with a norm, variability, growth, the effects of treatment—all these were at his disposal as he plotted and analyzed the profiles. It is obvious, from the above statement, that Dr. Hellman readily transferred his cranial studies to the living patient. What he at first observed and learned from the skull, he very

logically transferred to the head. The measurements of the dead were of use *only* as they told of the living. Dr. Hellman's long hours in the American Museum of Natural History, his countless thousands of precise measurements, came to fruition in his practice. The bones told their story, and he translated the story into the treatment of living tissue. It is an epitome of Dr. Hellman that he grew in orthodontic knowledge and insight with his own researches into growth.

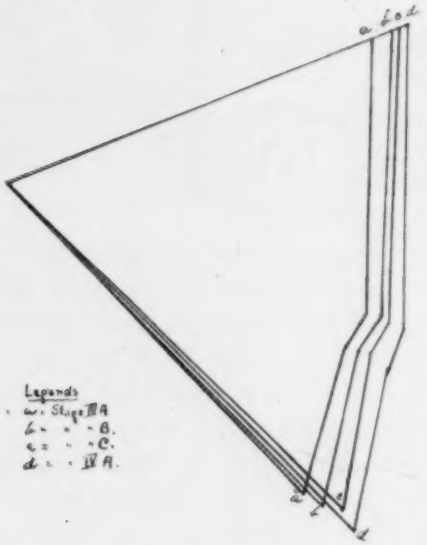


Fig. 4.

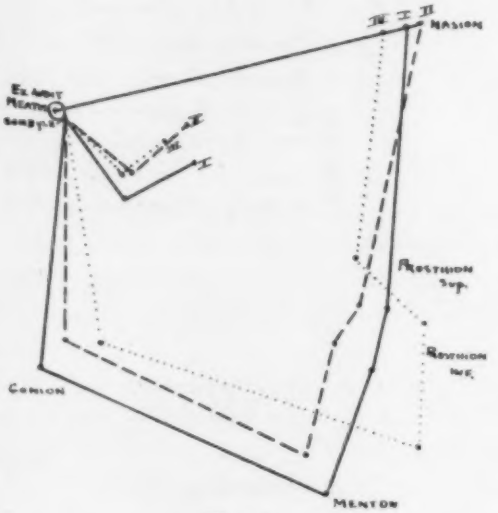


Fig. 5.

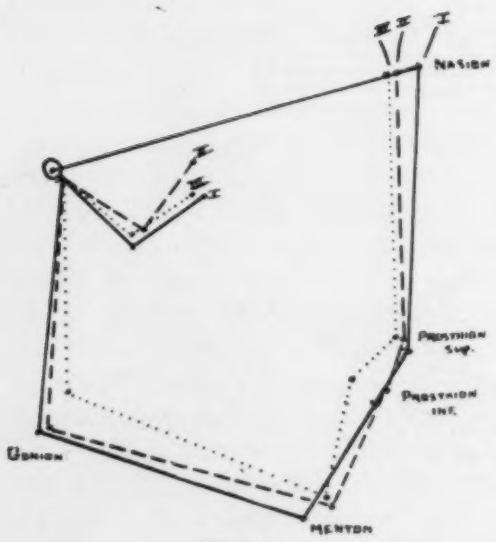


Fig. 6.

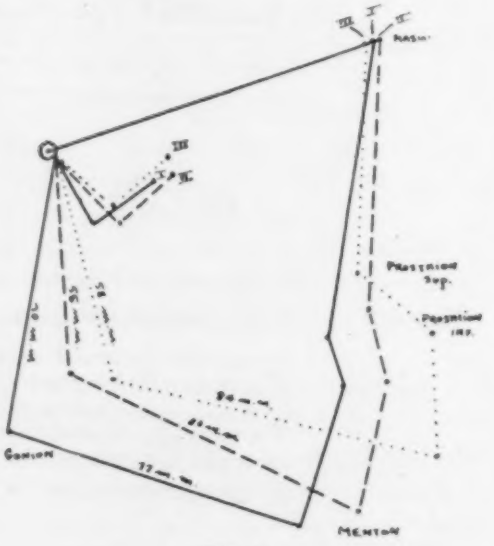


Fig. 7.

Fig. 4.—Facial profile (triangular) or girls in Stage III (*A*, *B*, and *C*) with Class II malocclusion (1931a, Fig. 26, p. 143).

Fig. 5.—Facial profile (quadrilateral); normal compared to Class II, division 1, and Class III (1927b, Fig. 6, p. 934).

Fig. 6.—Facial profile (quadrilateral); varying types of Class II, division 1 (1927b, Fig. 7, p. 934).

Fig. 7.—Facial profile (quadrilateral); varying types of Class III (1927b, Fig. 9, p. 937).

In his orthodontic practice, he routinely took a complete health history and a record of progress in height and weight. On the head he took length, breadth, height, and minimum frontal diameter (forehead diameter). The following facial dimensions were taken:

HEIGHT	BREADTH	DEPTH
Total (na-gn)	Bicondylar	Auric.-nasion
Upper (na-alv., na-inc., na-infra)	Bizygomatic	Auric.-subnasal
		Auric.-prosthion
Lower (inc.-gn., infra-gn.)	Bigonial	Auric.-alv. point
	Interpalpebral	Auric.-incision
Dental (alv.-infra.)	Nasal	Auric.-infradent
Nasal	Mouth (or lip)	Auric.-gnathion
Mouth (or lip)		Auric.-gonion
		Condylo-nasion
		Condylo-gnathion
		Gonion-gnathion

(Wherever *gnathion* is stated, it is to be noted that Dr. Hellman used the French, *menton.*)

Dr. Hellman was not content to let the profiles serve as the only evidence of variability. He very early used statistical tools for this purpose—he was especially fond of the *standard deviation* (S.D., sigma,σ). In 1921 (pp. 17-18 of reprint), he studied the relative disease resistance of breast- and bottle-fed babies.

	NUMBER OF CASES	AVERAGE NUMBER DISEASES		STANDARD DEVIATION
Bottle-fed	86	5.59	±	2.22
Breast-fed	70	4.04	±	1.83

He then tested for significance with the formula $\frac{\sigma}{\sqrt{n}}$ and arrived at the following results:

$$\text{Error first av.} \quad \frac{2.22}{\sqrt{86}} = \frac{2.22}{9.27} = .23$$

$$\text{Error second av.} \quad \frac{1.83}{\sqrt{70}} = \frac{1.83}{8.36} = .21$$

$$\text{Error of the diff.} \quad \sqrt{(.23)^2 + (.21)^2} = .3$$

The difference of the averages is 1.55 (5.59 – 4.04), which is about five times as great as the error of the difference (.3). "A difference to be real must be at least four times as great as the error. It is, therefore, quite safe in saying that there is a real difference in the incidence of diseases between the breast-fed and bottle-fed."

In his paper, "Variation in Occlusion" (1921), he based his entire discussion upon the standard deviation and error of the difference. In this paper, Dr. Hellman made a very cogent conclusion: ". . . We must use Johnson's newly proposed term 'Individual Normal' reservedly. . . . I would prefer the phrase 'individual variation.'"

Here Dr. Hellman was warning against the idea that there might be as many growth patterns as there are individuals. Certain it is that he recognized individuality, per se, but always within a predictable framework of measurable and assessable variability, determined statistically. Individuality run rampant is veritable growth anarchy; individuality predicted is growth under control.

It was quite natural for Dr. Hellman to extend the idea of the standard deviation to his profiles. An example may be taken from his Fig. 6, p. 431 (1931d) (Fig. 8 of this paper), study of "open-bite." On either side of the average profile there is a shaded area corresponding to $-1\ \sigma$ and $+1\ \sigma$. Within this range are the bounds of the "normal variation," as conceived by him. Upon this framework there is superimposed a case of Class I open-bite malocclusion to show not only deviation from an average (norm), but from normal variation ($\pm 1\ \sigma$) as well.*

In his 1939 and 1941 papers, Dr. Hellman carried his use of the standard deviation still further. He erected a vertical line which served as the average base line for each measurement taken (for *each sex* and *each dental age-group*). Then, on horizontal lines, again for each measurement, the limits of +1 S.D. and − 1 S.D. were delineated. The ends of each horizontal (± 1 S.D.) were then connected to give a vertical, symmetrical configuration which Dr. Hellman called his "wiggles." Fig. 3, p. 688 (1941b) (see also Fig. 4, p. 939, 1939) shows the general outline of such a "standard deviation diagram." (Fig. 9 of this paper.) The idea is to plot individual dimensions (i.e., the dimensions taken on an individual) upon such a diagram. Dr. Hellman felt that "normal" dimensions would fall *within* the diagram, while "abnormal" dimensions would fall *without* its bounds. Fig. 4, p. 689 (1941b) (see also Fig. 5, p. 939, 1939) shows two "normal faces" (both in Stage V, A), plotted on the basis of standard deviation diagrams (Fig. 10 of this paper). Devices such as these demonstrate Dr. Hellman's flair for graphic presentation and analysis of data.

It is not surprising that Dr. Hellman's studies in ontogeny were related to his early studies in phylogeny. It is as though he were stimulated to consider ontogenetic growth by a very intensive preoccupation with what might be termed evolutionary growth.† In his studies (1918, 1919b, 1920b, and 1942a), Dr. Hellman proved himself a competent comparative odontologist. While he focused his attention primarily upon the Primates, especially the great Anthropoids (orang, chimpanzee, gorilla), he studied also (via published reports) the placental mammals generally and the mammallike reptiles. In this summary, I venture to quote several conclusions from his 1919b study (p. 27 of reprint):

> That evolutional processes influencing such modifications as number, form, position and occlusion of teeth, constitute a noteworthy factor in the establishment of form in the dental arches not only of the various placental mammals in general, but also of the apes and man.
>
> That the forms of both the upper and lower dental arches in the anthropoids in the same individual *may conform* to the one outline, but in the *greater percentage of cases they differ.*

*In his paper "Normal Variation of Teeth and Jaws and Orthodonty" (1935c), Dr. Hellman emphasized the study of the bounds of variation in the analysis of cases to be treated.

†This phase of Dr. Hellman's researches is presented in greater detail by Dr. W. K. Gregory, p. 53.

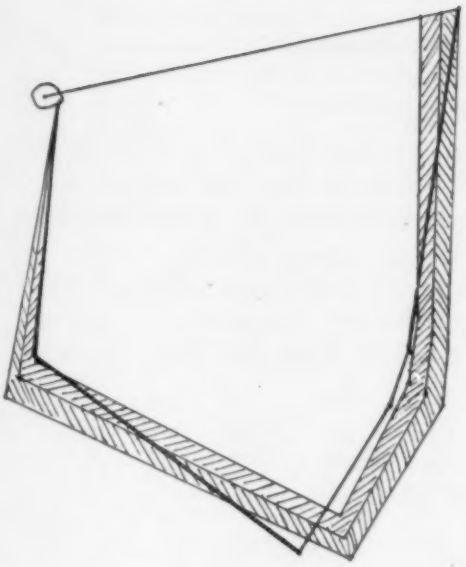


Fig. 8.

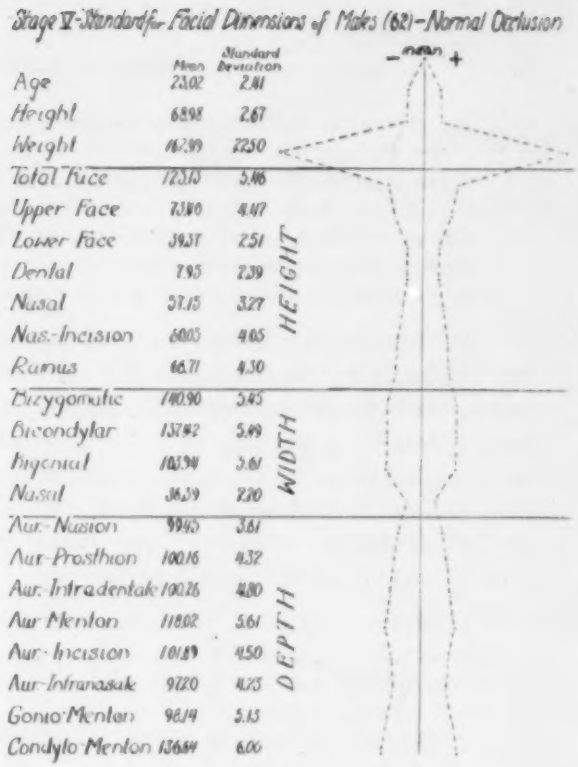


Fig. 9.

Fig. 8.—Use of profile to show +1 S.D. and −1 S.D. (shaded areas) to give idea of "normal" range (1931d, Fig. 6, p. 431).

Fig. 9.—The Standard Deviation Diagram (called "wiggles" by Dr. Hellman) in general configuration (1941b, Fig. 3, p. 688).

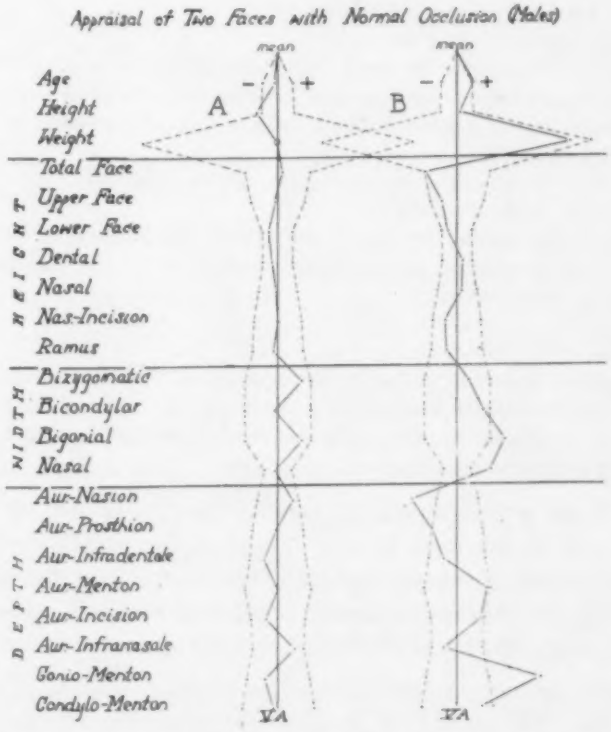


Fig. 10.—Two "normal" faces plotted on the S. D. Diagram (1941b, Fig. 4, p. 689).

That this difference may be due to a fundamental difference in the pattern of the teeth in the two jaws, as well as to the adherence to the primitive position of the molar teeth in the upper jaw.

The extreme diversity in form of the human dental arch fails to obscure similar conditions as in the anthropoids. Thus, the difference in tooth pattern in the two jaws, primitive position and occlusion, also produces in man a difference in the form of the two dental arches constituting one denture.

With the knowledge gained from his comparative craniological and odontological studies, Dr. Hellman was the better prepared to analyze the complex adjustments in human cranio-facio-dental growth and development. It has already been pointed out that he considered growth in three dimensions (or "planes," as he called them). We may now note his conclusions with respect to the interplay of growth in these dimensions. For this purpose, we may refer to his papers of 1927a, 1927b, 1927c, 1931b, 1933a, and 1935a. From his 1927a paper (pp. 512-513), we may quote as follows:

1. Growth in *height* of face is attained by:
   a. Moderate increase in dimension of the upper and lower face.
   b. Greater increase in the subnasal area and lower molar region, really the alveolar process.
   c. Development of the dentition, pushing, as it were, the upper and lower face apart.
2. Growth in *width* is attained by:
   a. Moderate increase in width in the median plane anteriorly.
   b. Greatest increase in width in the lateral halves posteriorly, especially at the gonion.
   c. Intermediate amount of growth posteriorly, ascending from the gonion and laterally between gonion and canine.
3. Growth in *depth* is attained by:
   a. Increase in dimensions of facial structures in anteroposterior direction.
   b. The increments taking place at the posterior end of the structures concerned, palate and alveolar process of the maxilla above, and alveolar process, ramus, and body of mandible below.
   c. The lower in position the structures are, the more rapidly they grow.
4. Adjustment of *Facial Position:*
   This is determined by measurements taken: from a point in the cranium (external auditory meati) to certain anterior points of the face in the median line (nasion, prosthion, and menton). These dimensions hitherto thought to measure growth are shown to measure position.
5. Modification of the Different Angles:
   The angles are shown to change in an opposite direction to the other measurements, i.e., the other dimensions grow larger during development while the angles grow smaller in degrees. The traditional idea of the modification of the mandibular angle cannot be upheld.

Emergent from a contemplation of the foregoing, Dr. Hellman came to dichotomize *growth* ("increase in size") and *differentiation* ("change in proportion and adjustment in position") (1933a, p. 1145). Furthermore, he was greatly impressed by *differing growth rates* and their effect upon variability. In his 1927b paper (p. 942), he observed as follows:

Different parts of the same face grow at different rates of speed at a given period of time. The same part grows at different rates of speed at different periods of time. This gives rise to variability in structure.

> Variability in structure gives rise to variability in parts composed of such structures.
>
> The face, consequently, varies in the same individual at different periods of life. It varies in different individuals at the same period of time, i.e., at the same age. It varies in different racial groups.
>
> Similarly the face varies in occlusal types. There is considerable variability in types of face, though belonging to the same race and possessing dentitions in normal occlusion.

In his 1933a paper (pp. 1143-45) Dr. Hellman is more explicit about the alternation of rates and times in the three "planes" of growth:

> The transverse dimension of the face is greatest in its increase in growth, the vertical is next in size, and the anteroposterior is smallest.
>
> During growth the largest dimension (width) increases least, the intermediate (height) more, and the smallest (depth) most. All dimensions are larger in the face of the male.
>
> When the face increases in width and depth, it does so more below, in the mandibular region, than above, in the bizygomatic and auriculonasion regions. When it increases in height, it does so more in back, at the ramus, than in front, as indicated by the total face height. These differences are more emphasized in the growth of the male face.
>
> During differentiation the face changes in proportion, becoming longer and deeper in comparison with its width; the female face becomes relatively longer and the male face relatively deeper.
>
> The changes in proportion of the three planes at different levels are greater in relative increase below in width and depth, and greater in relative increase behind in height. The changes are more marked in the male than in the female face.

For a graphic illustration of the rates of change in the several dimensions or planes, reference may be made to Figs. 1, 9, and 12 in Dr. Hellman's 1927a paper. Fig. 1 (p. 486) shows percentage addition and reduction in facial heights; Fig. 9 (p. 503) shows percentage additions and reduction in facial depths; Fig. 12 (p. 510) shows percentage additions and reductions in facial heights, widths, depths, positions, and angles. (Figs. 11, 12, and 13.)

Time and the researches of other students of faciodental growth and development have elaborated detail, have elucidated complexity, but they have not changed in any significant manner Dr. Hellman's fundamental postulates: growth in a three-dimensional system; interplay of growth rate in time and in morphologic area; and balanced integration of plane, rate, and morphologic area to give a normal, individual face. This was his ground plan: *to know the normal that he might assess deviation from it in kind and degree.* A malocclusion was not necessarily an attained aberrancy—it was a growth *process* out of balance, out of harmony. Not treatment alone, but *treatment with growth,* was the answer.*

Of particular interest to physical anthropologists is Dr. Hellman's discussion of sex and race differences in faciodental growth and in the teeth. Sex differences are discussed in his 1932 and 1933a papers. In general, growth di-

*Dr. Hellman, in addition to his three-plane growth analysis, paid attention also to more localized and/or specialized phenomena, e.g., the cusps of the teeth (1933b) and the role of M3 (1936b, 1938, and 1940b).

mensions in size are more marked in the male. The female face is relatively longer, the male face relatively broader and deeper. The female jawbones and dental arches are relatively more prognathous. In Fig. 2 (p. 927) in his 1927b paper, Dr. Hellman presented average male and female profiles (Fig. 14 of this paper).

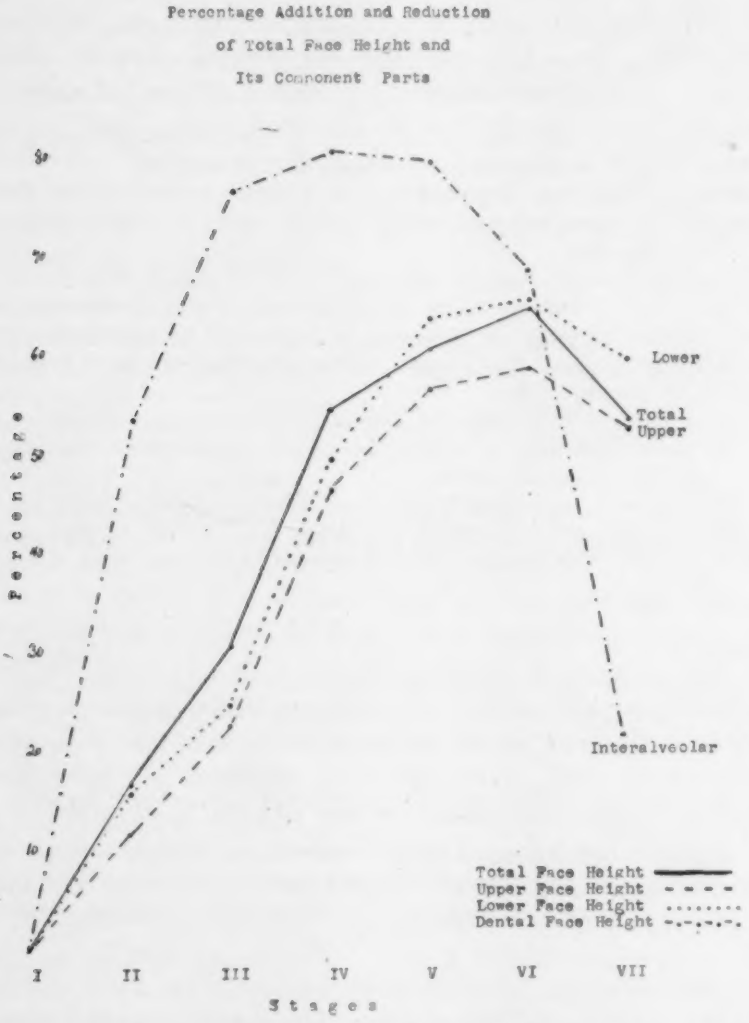


Fig. 11.—Growth (percentage) in facial height (1927a, Fig. 1, p. 486).

Race differences are discussed in Dr. Hellman's 1919a, 1919b, 1928a, and 1929 papers. In the 1919b paper (p. 27 of reprint), he said, "The Indians and Eskimos exhibit an edge-to-edge bite, while the Whites and Hindoos, a moderate over-bite, reaching an extreme condition in the Mongolians." The 1928a study concerns the manifestation of the so-called "Dryopithecus pattern" in the human dentition. He concluded (p. 174) "that as shown by the changes in crown pattern of the lower molar teeth, the most advanced stage is attained by

the modern Whites; the most primitive stage is retained by the West African Negroes, the Mongols being intermediate." His Fig. 7 (p. 165)* shows the stages in the drift from the "D.-pattern" to the "+4" (Fig. 15 of this paper). In his Fig. 14 (p. 198) (1929) Dr. Hellman presented facial profiles of white, Australian, and Hindu, using skulls (Fig. 16 of this paper).

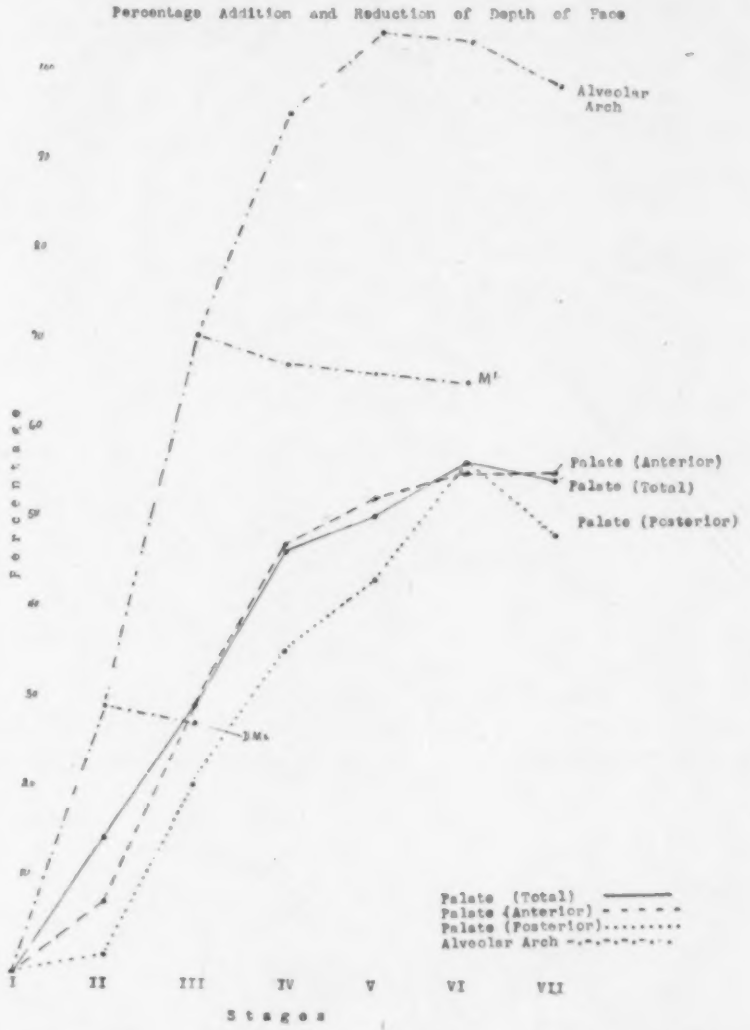


Fig. 12.—Growth (percentage) in facial depth. (1927a, Fig. 9, p. 503).

Dr. Hellman was quick to realize that extraneous factors might markedly influence the pattern and progress of growth. In an article entitled "Food and Teeth" (1925) he discussed the role of vitamins, sunlight and other light rays, calories, proteins, carbohydrates, fats, the amino acids, and the internal secretions. He also presented data on food and food habits as a factor in exposure

*See also Fig. 4, p. 177 (1940b); Fig. 16, p. 16 (1942).

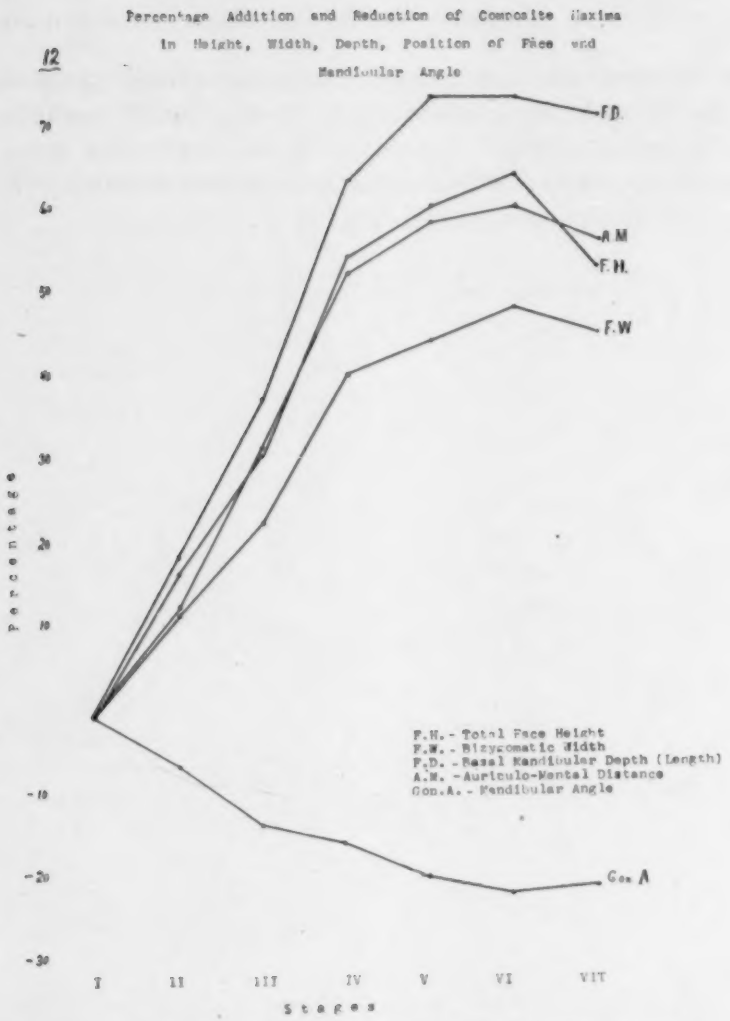


Fig. 13.—Growth (percentage) in facial heights, widths, depths, positions, and angles (1927a, Fig. 12, p. 510).

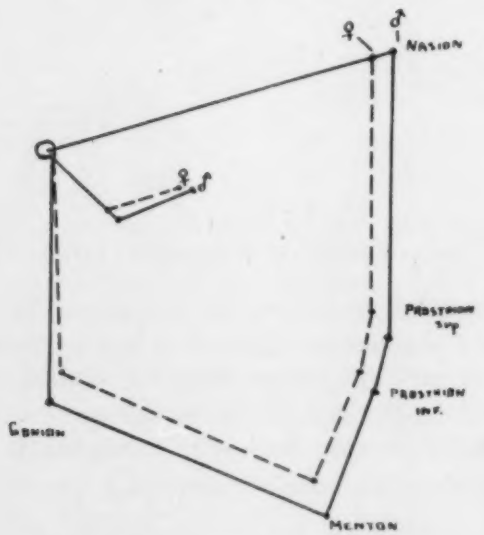


Fig. 14.—Sex differences in facial profiles (quadrilateral) 1927b, Fig. 2, p. 9227.)

of the roots at the neck of the tooth, and as a factor in the occurrence of dental caries, using the crania of Eskimos, American Indians, East Indians, and Australian aborigines as case material. In his 1922 paper on the etiology of Angle's Class II malocclusal manifestations, he discussed the role of ill health and disease.

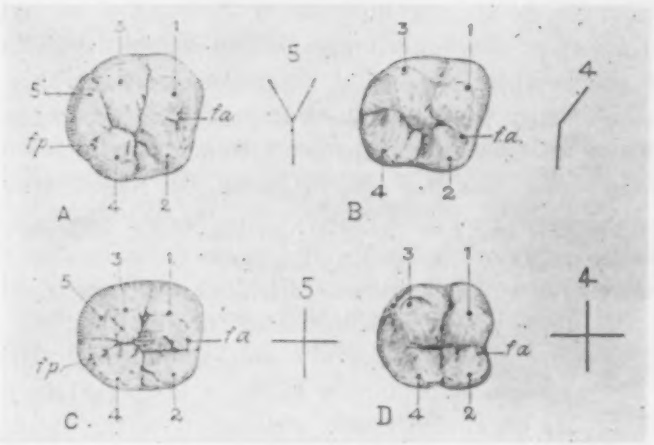


Fig. 15.—Reduction in the "Dryopithecus pattern" from a Y_5 to a T_4 (1928a, Fig. 7, p. 165).

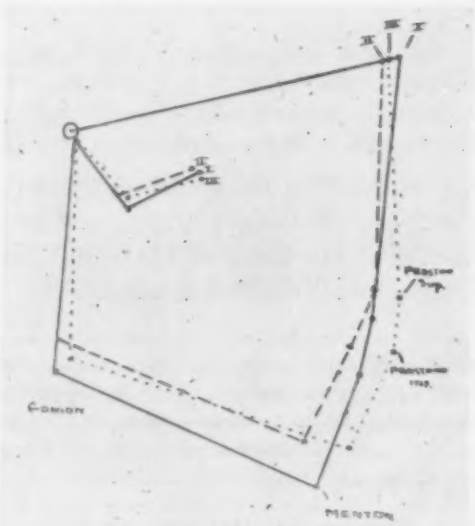


Fig. 16.—Racial differences in facial profiles (quadrilateral), based on skulls of white, Australian Aborigine, and Hindu (1929, Fig. 14, p. 198).

In all of his discussions of growth pattern and of the operation of extraneous factors upon that pattern, Dr. Hellman recognized the role of heredity, though he attempted no real genetic analysis. In his practice he was happy when he could get siblings for family line comparisons. In his 1925 paper, "Food and Teeth," he mentioned generational studies of malnutrition in rats. In his 1936a paper, he wrote as follows (p. 15 of reprint):

> Chins, jaws and faces are not products of orthodontia. They have been wished on us long before anyone thought of them. Faces of individuals with

> dentitions in normal occlusion do not all have uniform chins and jaws. . . . As a matter of fact, faces, jaws, chins and dentition are natural features which grow up together. . . . The extent to which each of them may grow is not depended upon, related to, or controlled by the others. They each have a certain amount of independence. On that account, all faces vary from each other, but each varies in a different way and to a different degree.

If this quotation be strictly interpreted, it seems as though Dr. Hellman were implying a sort of unit-inheritance (i.e., unit-growth) in the total pattern of faciodental relationships. None of his researches bear this out in precise detail, though his earlier work on the relationship of form to position of teeth (1919a) implies at least an independence of arch form and tooth position.

Dr. Hellman's use of dental age, in his stages, recorded his emancipation from chronological age. In 1928 (1928b) he published what we must regard as a very significant contribution, not only to orthodontia, but to the field of growth and development as a whole. His "Ossification of Epiphysial Cartilages in the Hand" is a veritable model of careful precision in observation, and reserved caution in interpretation and conclusion. He studied sixty girls with an average age, at beginning of the study, of 11.48 (σ 0.43), over a four-year period. He concluded "that ossification of the epiphysial cartilages of the hand occurs in four fundamental ways," which he designated as Stages A, B, C, and D (pp. 242-43):

> A. The cartilage disk narrows.
> B. The cartilage disk shows precipitation of bone or bud-like processes of ossification.
> C. The cartilage disk entirely disappears.
> D. There is differentiation of the bone structure in the ossified area.

Stage A appeared between 12 years, 36 days, and 12 years, 11 months. Stage D is completed between 14 years, 3 months and 15 years. Thus, "the entire process of ossification in the bones of the hand lasts somewhat less than three years." Dr. Hellman's final conclusion is as follows (p. 243):

> It may, therefore, be concluded that the period between the ages of 12½ and 14 years is replete with significant physiologic processes in this group of girls. The dentition of youth [M2] is completed, the epiphysial cartilages are undergoing the most active transformation and stature is increasing at its greatest rate. Moreover, accompanying these phenomena processes are taking place that subsequently bring about pubescence.

It is little wonder that to Dr. Hellman cranio-facio-dental relationships were one with the entire growing organism. Not chronological age, but biological age—dental and skeletal—was the North Star by which he set his compass of investigation. With such a course plotted, it is understandable that he so often made the sure voyage of careful diagnosis and achieved the safe harbor of felicitous result.

Up to this point, we have noted the tangibles of technique, of measurement, of observation, of interpretation, and of integration of knowledge and fact. This delineates Dr. Hellman, the researcher, the worker with caliper and x-ray. Let us now look at the intangibles, the philosophy, if we may use the term, of

approach. What, then, of Dr. Hellman, the thinker, the dreamer—even the visionary—the worker with ideas and aspirations? If we've noted the way and path to the goal, what of the goal itself?

Dr. Hellman was profoundly impressed that one of the goals of orthodontia was to proceed in compliance with the general ground plan of natural design. In his 1919a paper, "The Relationship of Form to Position in Teeth, and Its Bearing on Occlusion," he concluded (p. 54 of reprint):

> That since it is beyond the possibility of orthodontia to exert the slightest influence toward the modification of a tooth in its form, and since the tooth-form has retained most of its primitive features, it is imperative to base the modification in its position in accordance with these *ancestral characters*, following the plan as laid down by evolutionary record. For, unless the conditions are fulfilled first, there will always be a tendency on the part of Nature to assert herself by a modification of all orthodontic procedures not in accord with her dictates. If we would, therefore work *with* Nature and have her approval and assistance, we must confine our efforts to a more strenuous endeavor to learn to understand her, accept and appreciate her guidance by the recognition of her laws as laid down in the form of all *primitive characters* and their various modifications as found to be associated with the dentition of man.

For Dr. Hellman, Nature presented herself not only in an evolutionary manner, leaving an imprint of primitive and/or generalized characters, but in the vital dynamics of growth and development as well—perhaps even more graphically, and certainly more potently. *Working with Nature meant working with growth.* He never claimed for therapy what growth had gratuitously bestowed. In his 1933a paper (p. 1117), he stated (with italics for emphasis): "the *growth of the face is apparently not dependent upon the effect of orthodontic treatment, but that the success of orthodontic treatment may be dependent upon the effect of growth.*" In his 1927a paper (p. 17), he warned against "the risk of attempting to do something with orthodontic appliances that might be accomplished in the course of time by natural development." In his 1931a paper (p. 152), he stated as follows:

> It must, therefore, be concluded that since the diagnostic features of malocclusion of the teeth are inseparably connected with natural process of development, and since orthodontic treatment consists of artificial force exerted by mechanical devices upon living structures, it is necessary to be wary of the fact that the procedure must be made to conform to those conditions which constitute natural limitations to general growth phenomena. One should also realize that apparent discrepancies in growth very often disappear in the course of development, if unhindered by artificial encumbrances. It naturally follows that orthodontic treatment must never be undertaken until the orthodontist is reasonably certain that the natural growth changes involved in the development of the face and dentition will not complete the task in their own way.

In 1942b (p. 639), Dr. Hellman summarized his views on growth and orthodontic treatment by saying, "the most favorable time to gain desirable orthodontic results is the period of maximum facial growth."

Dr. Hellman's growth philosophy centers upon one word: *wait!*—not, however, the static quality of observing the status quo, but the dynamic ap-

proach of *watching while waiting*: the establishment of growth stage, the estimation of growth progress, and the analysis of growth trend toward (or possibly away from) remedial balance. This is seen in his 1931d paper (p. 444):

> . . . The method of diagnosing cases of malocclusion must rest upon a recognition of many other factors besides the occlusion of the teeth. These are the stage of development of the patient, and the change in the face, jaws, and dentition yet to take place during further development. The fact to be recognized is that, with increase in size, change in proportion and alternation in position of the face, there is also an accompanying effect which tends to modify the occlusion of the teeth. Upon the appraisal of this effect, then, will depend the diagnosis and prognosis of the case.

Dr. Hellman felt that his study of growth and development and their relation to malocclusion represented a distinct step forward in making orthodontia a more precise science. In his 1931c paper (p. 2173), he stated:

> It would seem, then, that, after all, the theoretical aspect of malocclusion does have a practical value. By the introduction of a scientific method for appraising malocclusion, a means is also furnished for an adequate understanding of the changes brought about by the mechanical procedures employed in orthodontic treatment.

The scientific method meant precision, it meant adequate statistical analysis, and it meant careful definition of concepts. As early as 1921 (p. 11 of reprint), he stated that "the imaginary ideal of the orthodontist cannot be found." There is, however, a workable ideal, "*Nature's ideal,* as expressed in the form of type—represented by the *average and its standard deviation.*" He expounded this theme with the statement that "the *average* . . . represents the '*normal,*' and the *range of variability* the *type.*" This was not merely word playing for Dr. Hellman; he was feeling his way toward a realization that variation, within predictable and measurable bounds, is a natural process of all organic life.

In this search for truth and understanding, Dr. Hellman was stern and forthright. "A conglomeration of facts, observations, and theories does not constitute a science any more than a heap of bricks, lumber, concrete and various other building materials constitute an edifice." (1920a, p. 18 of reprint.) He went on further to say "that an accumulation of observations, a collection of appliances, a manifold manner of their manipulation, and a variety of results do not constitute a profession." In his 1920b paper (pp. 6 and 7 of reprint), he warned that mere classification is not to be confused with diagnosis, which "is essentially a process requiring a separate course of procedure, and has for its object to ascertain the conditions anteceding the manifested malocclusion in the individual case." These strictures were dictated by a profound desire to place orthodontia on a sound basis of empirical science. If he were critical generally, it was because he was more than critical specifically—of himself. His paper entitled "Failures in Orthodontic Treatment" (1936c) is an excellent example of Dr. Hellman's ability to appraise his concepts and their pragmatic value as revealed by actual case histories. He, like all of us, learned much from failures. "Trial and error" are linked as a phrase—but don't forget that trial comes first! Growth and orthodontia were inseparable in Dr.

Hellman's mind. In a sense the two were in reciprocal relation. So, then, he concluded that in his field there were three fundamental needs (1936, pp. 344 and 345):

> 1. The need of that knowledge which has for its object the discrimination and recognition of those phases of development having a direct influence upon: (a) the eruption and shedding of the deciduous teeth; (b) the establishment of the alveolar and dental arches; and (c) the development of the Jawbones as well as of the entire face.
>
> 2. The need of that knowledge which has for its object the application of natural means (physiologic, or biologic, if you prefer) to promote the effects which are favorable, and intercept or eliminate those which are unfavorable to developmental progress.
>
> 3. The need of that knowledge, ability, and skill which have for their object the proper use and expert manipulation of those mechanical devices which are most expedient and of greatest benefit in routine practice when actual treatment cannot be averted.

We may well ask ourselves, "What *did* Dr. Hellman contribute to physical anthropology?" The answer comes clearly and simply, "He took the tools of Physical Anthropology and put them to work, and to use, in the service of Orthodontia." And in so doing he made his profession more precise, more scientific, and infinitely more hopeful of a successful future.* Without his pioneer craniometric studies and analyses, the present-day cephalometric studies—which are proving so fruitful—could have had no sure foundation. We might paraphrase: "The skull is dead, long live the head!"

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*Dr. Hellman also contributeed to physical anthropology his studies of human fossils; *Talgai*, *Punin*, and the *Australopithecinoe*. These have been discussed by Dr. W. K. Gregory.

†All titles are by Dr. Hellman.

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MILO HELLMAN'S CONTRIBUTION TO ORTHODONTICS

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I AM very glad of the opportunity to discuss Dr. Milo Hellman's contribution to the profession of orthodontics. Dr. Hellman was a man of keen mind and intellectual energy, enormous capacity for work, and with an unfailing scientific enthusiasm. Few men who have and none who have not carried out scientific investigations can have any idea of the time and energy that had to be expended in painstaking, accurate measurements of skulls. In one piece of work that he carried out, he examined 108 skulls, and at least seventy measurements were made on each one of these skulls.

I regret very much that for the last year conditions have been so disturbed for me that it has been very difficult to carry on consistently constructive work. I feel, therefore, that this contribution is very inadequate. It has been necessary to swallow material too greedily, to digest it imperfectly, assimilate it poorly, and, consequently, evaluate it very imperfectly. Quite recently, Dr. Graber, associated in my office, presented a review of the work of Milo Hellman, B. Holly Broadbent, and Allen G. Brodie, on the development of the face. This was an excellent piece of work and has not yet been published, but probably will be. It is accompanied by a very perfect bibliography of Dr. Hellman's work. This has been of the greatest assistance to me. I have used the material "*ad lib,*" and often without quotation marks; I want to express appreciation for the help it has been to me, and my grateful thanks to Dr. Graber.

I met Dr. Hellman first in New York, where we spent three months studying under Dr. E. H. Angle. We established mutual personal and scientific interests that became the basis of an enduring friendship. Dr. Hellman's contribution to orthodontics can perhaps be divided into three fields: his teaching, scientific publications, and his clinical influence as a practitioner. Some idea of the volume of his written contributions can be obtained from the fact that in thirty-five years he contributed over seventy articles, many of them reports of extensive scientific investigations. Undoubtedly, his study under Dr. Angle in New York, in 1908, was an important stimulant in his development. He became associated with such institutions as the American Museum of Natural History in New York City, and developed contacts with members of their staffs. In this way, he laid the background of his knowledge in paleontology, anthropology, and mammalian evolution. In later years, the dental and skull material brought back by many expeditions was sent to him for analysis, identification,

Presented before the Northeastern Society of Orthodontists, New York, N. Y., Nov. 11, 1947, as part of the Memorial Program in Honor of Milo Hellman.

and classification. By acquaintance with the members of the staff of these institutions, he greatly broadened his field of knowledge. The presentation of such material to the orthodontic and dental professions not only broadened the outlook of these professions, but gave their work an improved scientific standing among scientific men. It was through the study of such men as Brash, Sir Arthur Keith, Campion, Gregory, and Todd that Hellman's work and interests became developed in the field of growth and development of the human denture and face. Hellman himself said, "Since 1908 I have disciplined myself to measure skulls." This is a very modest statement, for in reality it means hundreds of skulls, both animal and human, and thousands of measurements. This anthropologic and paleontologic work made possible the results that he obtained in the study of the growth and development of the human face and denture by the cross-sectional methods—a method with inherent difficulties, dangers, and possibilities of mistakes, but the only one available at that time.

Throughout most of his life, Dr. Hellman was a teacher both in dental colleges and other such institutions, and in dental and orthodontic societies. To students he was very stimulating because of his clearness of thought, vigor of mind, and tendency to question well-accepted ideas. Some people, especially in dental schools, thought him negative in attitude. I think this is not the case, but Dr. Hellman was often so intent upon pointing out the error and showing why it was an error that he did not spend as much time in developing the facts and ideas which should replace the error. It is true also that these facts and ideas were so familiar to him that he did not always realize that they might not be as familiar to others. I shall show later how this worked in one instance.

Dr. Hellman's scientific work is probably his most important contribution to the profession. There is a rather definite direction and development in this scientific work. As already suggested, his first contribution presented to the profession his study, analysis, and correlation of the work of such men as Brash, Keith, Campion and Todd. This was very important, for it is notoriously true that comparatively few men in a profession will go back to the study of original sources, but that they will accept gladly the summarization of these sources by contemporary students. The next group are anatomical papers on the form of the teeth, their relation in occlusion, and their relationship to the form of supporting bones. In 1920, Hellman offered the first paleontologic analysis of Angle's classification of malocclusion. This paper pointed out that the relationship of the mesiolingual cusp of the upper first molar to the occlusal fossa of the lower first molar was the last and most fundamental remnant of the evolution of the dentition of the mammal. This was very important, for Dr. Angle has placed great emphasis on the claim that the first molars and especially the upper first molars were the most stable teeth in their positions with reference to the skull and in harmony with the pattern of the individual. He demonstrated the high percentage of upper first molar rotation, and this made the judging of the position of the first permanent molar from the buccal aspect alone confusing and deceiving; the rotation of these teeth so as to bring the mesiobuccal cusp into normal relation with the buccal groove of the lower molar as well as

the mesiolingual cusp was necessary in order to obtain or maintain the normal relation of the teeth anterior to the first molar.

The most important, most intensive, and most sustained effort of Dr. Hellman was his study of the development of the human denture and face, and this was of the greatest importance to the profession. I want to point out that at the time he was working on these subjects, the cross-sectional method was the only one available; that is, from large collections of skulls he arranged them as carefully as possible in groups representing the same age and stage of development. These groups were necessarily made of individuals of different individual patterns, and this introduced a difficulty and source of error. Todd made the basic criticism that all dead material was defective material. To this Hellman replied that it is true that a skull is dead, but it is the product of a living individual and living conditions, and is a true and reliable record of the conditions at the time of death. It is remarkable that in spite of the fact that he was compelled to use a method with great inherent possibilities for errors and mistakes, his conclusions parallel in every important respect the conclusions of Broadbent and Brodie; the differences are only in minor and comparatively unimportant features. This I consider the greatest compliment that could be made to Dr. Hellman's work on facial growth and dental development. For the study of development, the skull material was divided into five groups representing periods of development:

> Stage I designates that period of early infancy before the completion of the deciduous dentition.
>
> Stage II designates the period of late infancy at the completion of the deciduous dentition.
>
> Stage III designates the period of childhood, when the permanent first molars are erupting or have taken their position, in addition to which some or all of the deciduous incisors have been lost and are replaced by their permanent successors.
>
> Stage IV designates the period of pubescence, when the second permanent molars are erupting or have taken their position, in addition to which some or all of the deciduous canines and molars are lost and are being replaced by their permanent successors.
>
> Stage V designates the period of adulthood when the third molars are erupting or have taken their position.

The quality of the result from these studies was possible only because of the enormous number of careful, accurate measurements recorded, tabulated, and studied with intelligence. Tables were made for the dimensional changes of the upper face, lower face, dental height, symphysial height, and nasal height. Similar complete and exhaustive measurements were made for width and depth and the results summarized. Hellman used, recorded, and tabulated factual material to a very great extent, and became very expert in drawing correct conclusions from statistical material. This was possible only because he was always conscious of the difficulties and dangers of the methods which he was obliged to use. He constantly kept in mind such factors as the mean, the standard deviation, and the coefficient of error.

Five ways were found in which the face changes during development:

1. Growth in Height.
   a. Moderate increase in upper and lower face.
   b. Greater increase in subnasal area and lower molar region (alveolar portion).
   c. Developing dentition pushing upper and lower face apart.
2. Growth in Width.
   a. Moderate increase in median plane anteriorly.
   b. Greatest increase in lateral halves, posteriorly, especially at gonion.
   c. Intermediate growth posteriorly, ascending from gonion and laterally between gonion and canine.
3. Growth in Depth.
   a. Increase in dimensions of facial structures in an anteroposterior direction.
   b. Incremental growth at posterior surface of structures. (Palate and alveolar process above, ramus and body of mandible below.)
   c. The lower the structures are, the more rapid the growth.
4. Adjustment of Facial Position.
   a. Forward migration of entire mask as component structures grow backward.
   b. Accentuation of forward migration of mandible over that in maxilla.
5. Modification of Different Angles.
   a. Progressively more acute in nature.
   b. Mandibular angle an exception, with no change evidenced.

There would be, in my opinion, little or no value in discussing the comparatively unimportant details in which the final results of Dr. Hellman differ from those of Dr. Broadbent and Dr. Brodie studying the same problem with the longitudinal method, following the growth of the same individual throughout.

We come to the contributions of Dr. Hellman to the clinical practice of orthodontics. First and most important was his emphasis on growth. He says, for instance, in one phrase, "A child is treated by an orthodontist several years; the photographs taken before and after treatment show a very remarkable change of facial expressions. This change is claimed to be due to the orthodontic treatment. Are there no other factors involved in this change besides the appliances and the skill of the orthodontist?" It is true that the changes between the first and the last pictures are changes produced by growth and development. They are progress toward the attainment of the inherent potential of the individual type which was determined long before the treatment was undertaken. But the full possibility in the attainment of perfection in the type can only be accomplished with the full complement of teeth in normal occlusion. The orthodontist's part in the changes between the first and the last pictures is the placing of the teeth in such positions and relations to each other that the development of the full possibility of the type in perfection and balance can be obtained by growth and development. Dr. Hellman was trying to correct the extravagant and often foolish claims of some orthodontists. Hellman, first, and Broadbent and Brodie, much later, found that the individual type was determined very early in development, and that it could not be changed funda-

mentally. The perfection or imperfection of this attainment, however, could be modified in many ways, not the least often by malocclusion, and in the attainment of the potential of the type to its most perfect extent produced the best balance and the most artistic and esthetically satisfying result. Orthodontics, then, for Hellman was growth and not a problem of pushing teeth around by mechanical appliances. He often watched the progress of a case in undisturbed development sometimes a year or two before instituting any orthodontic interference, and he showed many cases in which a final very perfect condition had been attained without the use of mechanical interference at all.

The effective way in which Hellman, in my opinion, exerted the great and beneficial influence upon orthodontics was that he always put the emphasis on knowing what was needed to be done rather than upon the technique by which it was to be accomplished. Very clearly in his mind was the fact that orthodontic appliances do not move teeth. The appliance simply produces changes in the tissues, and changes in the tissues move the teeth. Still more important, during the whole period the teeth are moving in three dimensions of space they are changing their relations to other parts of the face and head. What the orthodontist should aim to do, as Hellman conceived it, is to modify that direction of growth so that the teeth will finally come into normal relations with each other and in the most perfect relations to the already determined type of the individual. Another contribution to clinical orthodontics which was, I think, first brought into attention by him was the study of orthodontic results ten, fifteen, twenty, or more years after their completion.

Certainly, few men have made greater or more important contributions to the scientific basis of orthodontics or more sincere and conscientious contributions to the practice of the profession.

55 E. Washington Street

RESOLUTIONS

Resolutions of the Northeastern Society of Orthodontists

On May 11, 1947, the dental profession was shocked to hear of the death of Milo Hellman at St. Joseph's Hospital in Far Rockaway, New York.

Dr. Hellman was born in Jassy, Romania, on March 26, 1872. He came to the United States in 1888, and became a naturalized citizen on Oct. 12, 1893.

Dr. Hellman leaves three daughters, Mrs. William T. Sandalls and Mrs. John L. Bull, Jr., of Far Rockaway, and Doris Hellman of Hollywood, California, a brother, Leo Hellman, also of Hollywood, and two grandchildren.

Dr. Hellman in early life was a talented flutist and was a member of the Pittsburgh Symphony Orchestra, which at that time was conducted by the late Victor Herbert.

He received his predental education at the New York Preparatory School, and entered the Dental School of the University of Pennsylvania in 1902, from which institution he was graduated with honors in 1905. He practiced dentistry for about three years in New York City, and soon became interested in orthodontics.

In 1908, after successfully completing a course at the Angle School of Orthodontia, he limited his practice to the latter science and continued to do so until his retirement in 1942, but remained as a consultant in orthodontics and continued in his research work.

His teaching career included lectures in orthodontics at the University of Pennsylvania and at the Dental School at Harvard University. In 1927 to 1928, he was Professor of Comparative Dental Anatomy, and from 1928 to 1929 was Professor of Orthodontia at New York University College of Dentistry. In 1932, he was appointed Professor of Dentistry at the School of Dental and Oral Surgery, Columbia University, where he carried on a research of the growth of the face and jaws. In 1917, he was appointed Research Associate in Physical Anthropology at the American Museum of Natural History.

Early in his practice, Dr. Hellman realized the need for extensive research in the field of orthodontics. This led him to the study of the evolution of the human dentition and the growth of the human face. He became deeply interested in anthropology and paleontology, and was soon recognized as a leading authority on these subjects.

He wrote more than seventy scientific papers, all of which were based on intensive study entailing a great expenditure of time and patience in making anthropologic measurements and biometric calculations of the human skull and face. Among these papers are the following: "Plesianthropus transvaalensis" (African ape man), "Variations in Occlusion," "Anatomy of Jaw Bones,"

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"Racial Characters in Human Dentition," "Ossification of Epiphysial Cartilages in the Hand," "Face in Developmental Career," "The Wisdom Tooth," "The Talgai Palate," and the "Dental Arch of the Orang."

He collaborated with William K. Gregory in many books and papers on the evolution of the human dentition, and made many restorations of the dentitions of ancient man and his forbears.

He studied the skeletal and fossil material at the American Museum of Natural History, the National Museum in Washington, the Hamann Museum of Comparative Anthropology and Anatomy in Cleveland, the Transvaal Museum in South Africa, and the Hunterian Museum of the Royal College of Surgeons, in London, England.

He received the honorary degree of Doctor of Science from his Alma Mater, the University of Pennsylvania, in 1933, and from the University of the Witwatersrand, Johannesburg, South Africa. (This was the first time such a degree was awarded to a dentist.) He was a fellow of the New York Academy of Sciences and its Vice-President in 1932 to 1933. He was a fellow of the American Association for the Advancement of Science, The American College of Dentists, and the New York Academy of Dentistry. He was an Honorary Fellow of the Odontological Society of the Union of South Africa and an Associate Fellow of the New York Academy of Medicine.

He received the Albert H. Ketcham Memorial Award in 1939 in recognition of his contributions to the science and art of orthodontics, and in 1937 he received an honorary citation as a testimonial to the diligence, experience, and skill which made his name a synonym for scientific devotion, for observational precision, and for breadth of understanding. This was awarded to Dr. Hellman by the Associated Foundations in Laboratory of Anatomy, Western Reserve University, Cleveland.

He held many important honorary posts on scientific committees of various organizations, such as: Member of the Committee on Growth and Development, White House Conference on Child Health and Protection, 1930; member of the executive group of committees for standardization of anthropologic lectures, International Congress Anthropologists and Ethnologists, 1937 to 1938; member of the American Association of Dental Editors; member of the editorial staff of *Archives of Clinical and Oral Pathology*. Honorary President, First International Orthodontic Congress, New York City, 1926; Honorary President, Second International Orthodontic Congress, London, 1931; member of the South African Expedition of the American Museum of Natural History in 1938; honorary member of the Southern Society of Orthodontists and the Mexican Orthodontic Society; charter member of the Society of Vertebrate Paleontology and the Society for the Study of Evolution; member of the International Association of Dental Research, and President of New York section, 1933; member of the American Association of Physical Anthropologists, the American Association of Mammalogists, the American Ethnological Society, the Society for Research in Child Development; the American Dental Association, the Dental Society of the State of New York, the first District Dental Society, The Ameri-

can Association of Orthodontists, and the New York Chapter of Delta Sigma Delta Fraternity. In March, 1947, he was unanimously elected an honorary member of the Northeastern Society of Orthodontists, which made him very happy.

By the death of Dr. Hellman we have lost a most beloved member whose outstanding professional character reflected the highest honor upon our society as well as upon the dental profession, and whose memory we should ever cherish, for by his unselfish labors we have been richly blessed.

It is fitting that we should record his personal qualities as they were revealed to all the members of this society and to the profession he loved so well. His was a sterling character. Its genuineness was ever reflected in his gentlemanly demeanor at all times. His high-minded sense of duty to the profession and to the public should ever serve as an inspiration and an emulation to those whose good fortune it was to know him.

It can truly be said of him,

> He scarce had need to doff his pride
> or slough the dross of earth,
> E'en as he trod that day to God
> so walked he from his birth;
> In simpleness and gentleness
> and honour and clean mirth.

WHEREAS, The members of the Northeastern Society of Orthodontists have learned with profound sorrow the untimely passing of their constant friend, beloved counselor, and everlasting benefactor, a man truly great to all men, Dr. Milo Hellman, and,

WHEREAS, Our specialty and the dental profession in general have been advanced along the highway of science, thanks to this kindly and unselfish man of learning, whose genial personality and penetrating mind have brought light to many of our darkest problems, and,

WHEREAS, His labors on orthodontic research are irreparably lost to the dental profession, which he served so unselfishly, and,

WHEREAS, Our members grieve over the departure of this distinguished and humble servant, an educator and scientist of international eminence, who dedicated his life in search of truth and light to the benefit of many now on earth and to myriads yet unborn. Therefore,

BE IT RESOLVED, That this sense of deep bereavement, though inadequately expressed, be spread upon our minutes as an everlasting memorial to him who labored long and well for the benefit of all mankind.

BE IT FURTHER RESOLVED, That a copy of these resolutions be sent to the members of his family as an expression of our sympathy and heartfelt condolence.

Respectfully submitted,
THE NECROLOGY COMMITTEE
RALPH WALDRON, Chairman.

Resolutions of the Eastern Association of Graduates of the Angle School of Orthodontia

Milo Hellman, D.D.S., Sc.D., was born at Jassy, Romania, March 26, 1872, and died at Far Rockaway, New York, May 11, 1947. It is with deep sorrow that we of the Eastern Association of Graduates of the Angle School of Orthodontia must enter upon our records the passing of one more of our members, another outstanding pioneer in orthodontics.

No more fitting tribute could be penned to express Milo Hellman's life than the following by Edgar Fahs Smith, once his provost:

> The wisest could ask no more of fate
> Than to be simple, modest, manly, true,
> Safe from the many, honoured by the few;
> Nothing to count in world, or church or state,
> But inwardly in secret to be great.
> To feel mysterious Nature ever new,
> To touch, if not to grasp, her endless clue,
> And learn by each discovery how to wait,
> To widen knowledge and escape the praise;
> Wisely to teach because more wise to learn,
> To toil for science, not to draw men's gaze . . .

Magnificent was the man in his perseverance, tenacity, and fortitude, always seeking to learn, then endeavoring to interpret. Early in his youth, Dr. Hellman began to study music. Coming to this country at the age of 16, he continued with the flute, ultimately becoming a member of the original Pittsburgh Symphony Orchestra under Victor Herbert. With the money he was able to save, he decided that a professional career was more to his liking than music, and upon completing his high school education at the New York Preparatory School, matriculated at the Dental School, University of Pennsylvania, graduating in 1905. There he belonged to the Truman Society and the Epsilon Chapter of Delta Sigma Delta. In 1933, his Alma Mater honored him with the Doctor of Science degree.

In 1908, when Dr. Angle moved his school to New York, Hellman decided to take the course and there found as classmates Harry E. Kelsey, John Mershon, and Fred B. Noyes. These four, having much in common, worked together and established a friendship that continued throughout the years. All four later played an important part in directing the future course of the specialty.

At the next session of the school in New London, Connecticut, in 1909, Dr. Hellman was demonstrator in model making, and as so often it is said that from acorns mighty oaks develop, so it was to be with our departed friend. As a result of the affiliations in the school, there resulted a close and personal friendship with Dr. Angle as well as with the other members of the faculty, especially Raymond C. Osburn. The latter was to furnish him the inspiration for study and research that brought him in contact with Henry Fairfield Osborn, Aleš Hrdlička, Clark Wissler, Franz Boas, and, later, William King Gregory. Hellman's interests thereby broadened, and at his death he was an

active member of the American Association of Physical Anthropologists, American Association of Mammalogists, American Ethnological Society, Society for the Study of Child Development, Society of Vertebrate Paleontology, and Society for the Study of Evolution.

In the early years of this association, the planned activities, an idea that was his own, included special courses that were given by outstanding men. He saw the advisability of going beyond these, and first took at Columbia the course in biology under Thomas Hunt Morgan and vertebrate paleontology under Gregory. Both subjects proved of invaluable help in his later writings and thinking.

In the meantime, in 1917, he had become research associate in physical anthropology at the Museum of Natural History, a position he retained up to his demise, and a member, a Fellow, and Vice-President of the New York Academy of Sciences. It was in 1924 that he joined the American Association for the Advancement of Science, and in 1931 was the recipient of their Fellowship.

While orthodontics was Dr. Hellman's vocation, physical anthropology and paleontology were to become more than an avocation with him. The teacher (Gregory) and the student (Hellman) joined forces and together began the serious study of the fossilized remnants of the animals of the Pleistocene Age, and, in collaboration, they published the following: First, in 1926, the "Dentition of Dryopithecus and the Origin of Man;" in 1938, "Fossil Anthropoids of the Yale-Cambridge-India Expedition of 1935; in 1939, "On the Evolution and Major Classification of the Civets (Viverridae) and Allied Fossil and Recent Carnivora: A Phylogenetic Study of the Skull and Dentition."

In 1938, as members of the American Museum of Natural History's Expedition to South Africa, Gregory and Hellman studied the fossil fragments of a prehuman being discovered by Dr. Robert Broom of Transvaal Museum, and together they published: "The Dentition of the Extinct South African Man-Ape Australopithecus (Plesianthropus) Transvaalensis Broom, A Comparative and Phylogenetic Study"; "The Upper Dental Arch of Plesianthropus Transvaalensis Broom, and Its Relation to Other Parts of the Skull"; and "The South African Fossil Man-Apes and the Origin of the Human Dentition."

In the Museum is Hellman's concept and reconstruction of the skull itself. While in South Africa, he was the recipient of a second honorary Doctor of Science degree from Witwatersrand University in Johannesburg.

In recognition of his scientific achievements, Milo Hellman gained the keys of the Omicron Kappa Upsilon and Sigma Xi Honorary Fraternities.

During the short life of the Alumni Society of the Angle School, Hellman was an active member, serving on its Executive Committee, and during 1910 to 1912 he edited the last two volumes of the *American Orthodontist*. His other editorial tasks were the *Bulletin of the First District Dental Society*, and on the *Journal of Dental Research*.

Hellman's first important paper was presented at the 1912 meeting of the Alumni Society; it was entitled, "Bone Tissue, Its Growth and Development. A Résumé," and was published in Vol. 3 of the *American Orthodontist*.

The works under consideration were by F. B. Noyes, Albin Oppenheim, and Sir William Macewen. We quote from his introductory paragraph the following:

> Urged by the desire to learn in a general way what the scientific world may have contributed to this phase of our work, I gave a great deal of time in the pursuit of several studies with the aim in view to find some explanations pertaining to the complex problems we are called upon to solve.
>
> I undertook the task of preparing and submitting to this meeting a *résumé,* by which I am in hopes of rousing your interest in this particular direction to a greater extent than hitherto shown. I shall furthermore endeavor, by means of frequent comparisons, to arrive at some logical deductions that may prove of value in the practical application of Orthodontia.

For the next thirty-five years, Hellman was actively engaged in trying to unravel the maize of problems that began that day back in 1912. Unfortunately, he was never able to complete his life's effort and to see the day that his two important contributions would appear in print. Fortunately, his notes are in such shape that they can readily be assembled for publication.

While Dr. Hellman held membership in many dental and orthodontic organizations, it is his activity in the Eastern Association that we wish to record. A charter member, he served as its first Secretary-Treasurer, 1909-10; as President, in 1912-13, and as Vice-President, 1911-12, and again in 1941 until his demise. The Association was always dear to him, and he gave it much of his time and energy. As a member of its Executive Committee, most of the time its Chairman, he directed its activities, and, due to his far-sightedness, his background, wisdom, and contacts, he managed to keep our meetings on the highest scientific level, always steering away from papers on appliances, etc.

Hellman sought and secured essayists outstanding in their varied fields of science, who made each meeting not only interesting but important as landmarks in the development and evolution of orthodontics. Many of the studies first presented before this Association later found an important place in dentistry. It is not necessary at this time to record his contributions, for they are a part of our recent booklet, "The Contributions of the Eastern Association of Graduates of the Angle School of Orthodontia to the Science and Practice of Orthodontics."

For his stimulation and interest in the furthering of orthodontics, he was the recipient of the Albert H. Ketcham Memorial Award in 1939, and in 1937 received the Honorary Citation of Western Reserve University.

At one time, he held the chair of orthodontics at the New York University School of Dentistry, and lectured at Harvard, Pennsylvania, and Columbia.

He has now joined those who have passed on and will not be forgotten as long as orthodontics exists, and as he himself once wrote: "A band of fellows with like ideals will probably never form a closer circle and never achieve higher aims."

We of the Eastern Association of Graduates of the Angle School of Orthodontia cherish the memory of his comradeship and his active and sympathetic participation in the advancement of orthodontics.

For these many reasons, BE IT RESOLVED that the Eastern Association of Graduates of the Angle School of Orthodontia recognizes in this tribute its debt to and appreciation of his work.

BE IT FURTHER RESOLVED, that this record be added to the minutes of this Association, and a copy be sent to his family and to the AMERICAN JOURNAL OF ORTHODONTICS.

They are passing away, these dear departed friends,
Like leaves on the current cast
With never a break in the flow
We watch them as one by one they go
Into the solemn past.—*D. W. Flint.*

BERNHARD WOLF WEINBERGER, President
E. SANTLEY BUTLER, Secretary
ALFRED M. DESNOES, Treasurer

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Compiled by Edith Hellman Bull

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1944. Diagnosis in Orthodontia and the Method of Technique I Use in Practice (read before the Chicago Association of Orthodontists, Chicago, Ill., July 12, 1943), Angle Orthodontist **13**: 3-14, January-April, 1944.

Fundamental Principles and Expedient Compromises in Orthodontic Procedures (read as part of the Extraction Panel, the American Association of Orthodontists, Chicago, Ill., April 26, 1944), Am. J. Orthodontics and Oral Surg. 30: 429-436, August, 1944; also in Tr. Am. Assoc. Orthodontists, 1945.

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DISCUSSIONS OF WORKS OF OTHER AUTHORS*

1910. The Influence of Civilization on the Evolution of the Bones of the Face, by G. M. Wright, Am. Orthodontist 2: 43, July, 1910.

1911. The Application of the Expansion Arch, by J. Lowe Young, Am. Orthodontist 2: 141-145, January, 1911.

1913. Orthodontia for the General Practitioner, by Abram Hoffman, Items Interest 35: 535-536, July, 1913.

Studies of Anterior and Posterior Occlusion of the Teeth, With Suggestions as to Treatment, by M. H. Cryer, Dental Cosmos 55: 735-736, July, 1913.

1914. Lymphadenitis in Infants and Children, by Oscar M. Schloss, Dental Cosmos 56: 1255-1256, 1258, November, 1914.

1915. The Importance of Sound Temporary Teeth to Facial Growth and Development, by J. Lowe Young, Dental Cosmos 57: 1168-1171, October, 1915.

Art and Orthodontia, by J. A. Cameron Hoggan, Dental Cosmos 57: 1275-1276, November, 1915.

1916. Physical Defects as Found in Children of the School Age, by A. E. Shipley, Dental Cosmos 58: 816, 819, July, 1916.

Types, Diatheses, Constitutions and Tendencies Toward Various Diseases in Infants and Children, With Special Reference to Deformities of the Face and Mouth, by Herman Schwarz, Dental Cosmos 58: 816, 819, July, 1916.

1917. Diagnostic Methods in Determining Feeble-mindedness, by Louis E. Bisch, Dental Cosmos 59: 544-546, May, 1917.

Malocclusion as a Problem in Pathology, by Edward C. Kirk, Dental Cosmos 59: 633-634, 637, June, 1917.

Some Engineering Principles of Possible Interest to Orthodontists, by Gilbert Dudley Fish, Dental Cosmos 59: 921, September, 1917.

1918. Movement of Teeth Predetermined by Engineering Instruments: Appliances Designed in Accordance With Analytical Mechanics, by F. L. Stanton, Dental Cosmos 60: 70, January, 1918.

An Experimental and Clinical Study of the Isolated Thyroid Hormone, by N. W. Janney, Dental Cosmos 60: 159, February, 1918.

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On Healthy and Diseased Conditions of the Alveolar Processes of the Jaws, by A. Hopewell-Smith, Dental Cosmos 60: 438, May, 1918.

Evolution of Orthodonty, by William K. Gregory, Dental Cosmos 60: 435-436, May, 1918.

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1919. The Individual Normal—the Problem of Orthodontia, by A. LeRoy Johnson, Int. J. Orthodontia 5: 322-324, June, 1919; also in Dental Items Interest 41: 856-859, November, 1919.

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Some Notes on the Eruption of Teeth, by Franz Boas, Dental Cosmos 62: 392-394, March, 1920.

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Orthodontic Limitations, by F. C. Kemple, Dental Cosmos 62: 1350-1352, November, 1920.

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*The reference given is to Dr. Hellman's discussion, not to the original work.

Report on Studies of the Effect of Vitamin Deficient Diet Upon the Teeth, by Percy R. Howe, Dental Cosmos **63**: 1155-1156, November, 1921.

On the Pathology and Diagnosis of Distoclusion, by B. E. Lisher, Int. J. Orthodontia **7**: 668-669, December, 1921.

1922. The Influence of the Forces of Occlusion on the Development of the Bones of the Skull, by Lawrence W. Baker, Tr. Am. Soc. Orthodontists, 21st meeting, pub. 1922, p. 74.

The Limitations of the Lingual-Arch Appliance, by Robert H. W. Strang, Dental Cosmos **64**: 93-94, January, 1922.

1923. A Review of Some Recent Literature on the Endocrine Glands, by Albert W. Crosby, Dental Cosmos **65**: 310, March, 1923.

The Endocrine Glands in Relation to Dental Nutrition and Caries, by C. E. De M. Sajous, Dental Cosmos **65**: 763-768, July, 1923 (Tables 1-2).

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1924. The Antiseptic Potency of Neutral Acriflavine as Applied in the Practice of Orthodontia, by H. C. Ferris, Dental Cosmos **66**: 204, February, 1924.

Endocrine Disturbances, by Albert W. Crosby, Dental Cosmos **66**: 207, February, 1924.

A Consideration of the Structure of the Alveolar Process, With Special Reference to the Principles Underlying Its Surgery and Regeneration, by Hugh W. MacMillan, J. Dent. Research **6**: 263-268, September, 1924-1926 (Figs. 5-8).

1925. Orthodontia's Contribution to Dentistry, by A. LeRoy Johnson, Dental Cosmos **67**: 377-379, April, 1925.

The Relation of Nutrition to Preventive Dentistry, by R. H. Rose, D. Digest **31**: 777-782, November, 1925.

1927. Investigations on the Orbital Plane Proposition Recently Advanced in Orthodontia, by B. Holly Broadbent, Dental Cosmos **69**: 419-420, April, 1927.

A Consideration of Latest Attempts at Improvement Upon Angle's Classification, Together With Account of Original Device for the Recording of Dento-facial Cranial Relations, by A. Wolfson, Dental Cosmos **69**: 419-420, April, 1927.

The Interpretation of Dental Lesions in the Light of Recent Research, by Percy R. Howe, J. Dent. Research **7**: 149, June, 1927.

An Investigation Into the Relationships of the Facial Musculature to the Hand Pressure and Vital Capacity, by Benjamin Lancet, Dental Cosmos **69**: 578-579, June, 1927.

1929. A Critique of Simon's Diagnostic Methods, by Frederick L. Stanton, Tr. Am. Soc. Orthodontists, 27th meeting, pub. 1929, pp. 187-189.

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An Outline of the Course in Orthodontia at Columbia University, by Leuman M. Waugh, Dental Cosmos **72**: 512-513, May, 1930.

An Adequate Course of Instruction in Orthodontia, by Guy S. Millberry, Dental Cosmos **72**: 502, May, 1930.

Undergraduate Teaching of Orthodontia, by Frederick B. Noyes, Dental Cosmos **72**: 521-522, May, 1930.

Thumb-sucking: A Cause of Malocclusion in the Deciduous Teeth, by Samuel J. Lewis, J. A. D. A. **17**: 1073, June, 1930.

Growth and Time Corrections Between Ossification Centers in the Long Bones and Calcification Centers in the Mandibular Dentition of the Cat. A postnatal Roentgen-ray Study, by Harry H. Shapiro, Int. J. Orthodontia, Oral Surg., and Radiography **16**: 702, July, 1930.

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1931. Dental Education, by Frank M. Casto, J. Dent. Research **11**: 428-429, June, 1931.

Relationship Between Diet and Dental Caries, by E. V. McCollum, J. Dent. Research **11**: 566-568, August, 1931.

1933. The Orthodontic Value of Cephalometric Studies in Facial Growth With the Roentgenographic Cephalometer: The Use of X-ray Silhouettes in Tracing Facial Growth, by B. Holly Broadbent, J. Dent. Research **13**: 153-154, April, 1933.

1935. Problems of the Dual Bite With Particular Reference to the Temporomandibular Articulation, by Alfred P. Rogers, Int. J. Orthodontia **21**: 48, January, 1935.

Straightening Teeth, by B. W. Weinberger, Int. J. Orthodontia **21**: 423-424, May, 1935.

Observations on a Few Problems of Orthodontia, by Fred C. Kemple, INT. J. ORTHODONTIA 21: 612-614, July, 1935.

Growth, by Franz Boas, INT. J. ORTHODONTIA 21: 922-926, October, 1935 (Figs. 1-5, Tables 1-2).

Normal Variation of Teeth and Jaws, and Orthodonty, by Aleš Hrdlička, INT. J. ORTHODONTIA 21: 1108-1114, December, 1935 (Figs. 1-7, Tables 1-3).

1941. Analysis of Malocclusion, Based Upon the Forward Translation Theory Technique of Correction With the Pin Appliance, by George W. Grieve, AM. J. ORTHODONTICS AND ORAL SURG. 27: 339, June, 1941.

MISCELLANEOUS UNPUBLISHED MATERIAL PRESENTED BEFORE SCIENTIFIC GROUPS

1910—1947

1910. An Extract From Dr. Angle's Book on Class III, Reviewing the Following Topics: The Key to Occlusion, Classification of Causes of Malocclusion; Class III, Etiology, Diagnosis and Treatment, read before the Eastern Association of Graduates of the Angle School of Orthodontia, January, 1910.

1911. Some Extremely Developed Cases of Malocclusion; A Clinic, presented before the Dental Society of the State of New York, May, 1911.

1912. Topographical Anatomy. Part of Symposium on Orthodontia. A clinic. (Practical demonstration of photographs and specimens bearing on the topographical anatomy of the upper alveolar process and its adjacent air cavities, their functional significance, and the therapeutic value of modern orthodontic treatment.) Presented by the Eastern Association of Graduates of the Angle School of Orthodontia with F. L. Stanton, J. L. Young, E. S. Butler, and B. W. Weinberger, before the American Laryngological, Rhinological, and Otological Society, Philadelphia, Pa., May 14, 1912.

Discussion of "Biometrics," by R. H. Lowie, before the Eastern Association of Graduates of the Angle School of Orthodontia, April, 1912.

1913. The Report of the Journal Committee (the American Orthodontist) of the Alumni Society of the Angle School of Orthodontia (With George B. Palmer, Harry E. Kelsey, Frederick B. Noyes, and B. W. Weinberger), January, 1913.

1914. Report of Case of Two Children in the Same Family, Being Ordered by Their Physician to Remove All Appliances as They Were Causing Glandular Trouble; A Case Report, presented before the Eastern Association of Graduates of the Angle School of Orthodontia, January, 1914.

1918. Discussion of "Consideration of Some of the Biological Problems Underlying the Science of Orthodontia" by A. J. Goldfarb, before the American Society of Orthodontists, Chicago, Ill., Aug. 1, 1918.

1920. Observations on Ossification and Its Bearing on Orthodontic Treatment, read before the Dewey Alumni Society, Chicago, Ill., April, 1920.

1922. Results of Two Treated Cases; a case report, presented before the Eastern Association of Graduates of the Angle School of Orthodontia, January, 1922.

1925. The Lower First Molar, One of the Missing Links in the Evolution of Man, read before the Eastern Association of Graduates of the Angle School of Orthodontia, February, 1925.

Tooth Form in Relation to Dental Caries, read before the New York Academy of Dentistry, New York, Jan. 22, 1925.

1927. Round Table Discussion: From an Entirely Practical Standpoint and From Observation in Day to Day Practice, What Is the Present Reaction to the Proposition of Root Absorption During Orthodontic Treatment (With A. H. Ketcham), presented before the American Society of Orthodontists, Chicago, Ill., May, 1927.

1928. Presentation and Discussion of Class II Cases and Others Characterized by Deep Overbite; a clinic, presented before the Eastern Association of Graduates of the Angle School of Orthodontia, May, 1928.

1929. A Case Report, presented before the Eastern Association of Graduates of the Angle School of Orthodontia, May, 1929.

1930. Discussion of Dr. Raymond A. Dart's paper: "The Dentition of *Australopithecus*," read before the American Society of Mammalogists, New York, May, 1930.

Discussion of T. Wingate Todd's paper: "Further Development of the Dental Arches," read before the American Society of Orthodontists, Nashville, Tenn., April, 1930.

1931. The Face and Teeth of the Growing Child; a radio talk, Chicago Dental Society Broadcast, Feb. 4, 1931.

1932. A Case Report, presented before the Eastern Association of Graduates of the Angle School of Orthodontia, November, 1932.

A Preliminary Study of Profiles of Human Faces, read before the American Association for the Advancement of Science (Section on Anthropology), Atlantic City, N. J., Dec. 30, 1932; also read under title, "How We Wear Our Faces," before the Eastern Association of Graduates of the Angle School of Orthodontia, New York, Oct. 9, 1933.

The Face and Teeth of Man, read before the American Association of Physical Anthropologists, Washington, D. C., March 22, 1932.

Some Effects of Orthodontic Treatment on the Growth of the Face, read before the Eastern Association of Graduates of the Angle School of Orthodontia, May, 1932.

A Project for Research Concerning a General Aspect and Significance of Malocclusion of the Teeth, submitted to Dean Alfred Owre, Columbia University, 1932.

1934. Sequence in Shedding of Deciduous Teeth and Eruption of Permanent Teeth, orthodontic exhibit presented at the New York Dental Centennial, December, 1934.

Observations on Arch Form in Anthropoids, read before the American Association of Physical Anthropologists, New York, May 10, 1934.

1935. Final Results, read before the Eastern Association of Graduates of the Angle School of Orthodontia, January, 1935.

Learning, Experience, and Research, read before the Columbia University Orthodontic Staff, June 4, 1935.

1936. Orthodontic Practice in Its Modern Setting; Some Views on Theoretical Aims and Practical Achievements, read before the Associated Physicians of Montclair, N. J., Mountainside Hospital, March 27, 1936.

1937. Symposium on Orthodontia: A Consideration of the Broader Principles Underlying the Preparation for Practice of Orthodontia (with F. B. Noyes and L. Waugh), before the First District Dental Society, New York, Feb. 1, 1937.

1938. Discussion of "The Phylogenetic Relationships of *Sinanthropus* With Special Reference to the Dentition" by Franz Weidenreich before the New York Academy of Sciences, New York, May 6, 1938 (with W. K. Gregory, J. H. McGregor, G. Pinkley, and H. L. Shapiro).

1940. The Restoration of the Dentition of *Pithecanthropus erectus*, read before the American Anthropological Association, in conjunction with the American Folklore Society, Society for American Archeology, American Association for the Advancement of Science, Philadelphia, Pa., Dec. 30, 1940.

The Faces of Our Cases, read at the Orthodontic Conference, University of Southern California, August, 1940.

1941. When Are Impactions Really Impactions and How Are They to Be Diagnosed? Read before the New York Society for Oral Diagnosis, New York, March 19, 1941.

Discussion of Brigadier General Leigh C. Fairbank's paper: "Dental Requirements and Selective Service," read before the New York Academy of Dentistry, New York, Jan. 9, 1941.

Exhibit illustrating the history of dentistry and the evolution of anthropoid and human teeth (With B. W. Weinberger and W. K. Gregory), Special exhibit for the fortieth meeting of the American Association of Orthodontists at the American Museum of Natural History, New York, May, 1941.

Discussion of "The Earliest Known Fossil Stages in the Evolution of the Oral Cavity and Jaws" by W. K. Gregory, before American Association for the Advancement of Oral Diagnosis, New York, Nov. 14, 1941.

1942. The Directions of Growth of the Face and Its Influence on the Developing Occlusion, read at the Inter-American Orthodontic Congress, March 20, 1942, New Orleans, La. (Part of series of lectures and clinics on "Fundamentals of Orthodontics.")

The Development of Occlusion, read at the Inter-American Orthodontic Congress, March 20, 1942, New Orleans, La. (Part of series of lectures and clinics on "Fundamentals of Orthodontics.")

1942-1947. [Preparation of manuscript for a general work on orthodontia and its problems].

Angle School of Orthodontia Class Picture, 1908

Standing, back row, reading from left to right: Bethea; Blaine Truesdell; Allen; Raymond C. Osborn, teacher; William Cavanagh; Sheldon Friel; Cecil George Moxham; William D. Riggs.

Standing, second row: Harry E. Kelsey; George D. Goodenough; Frederick B. Noyes, student and teacher; Martin Dewey, teacher; John V. Mershon; Alfred M. Desnoes; Albert F. Wayne.

Seated: Albert H. Ketcham, teacher; E. H. Weurpell, teacher, artist; Edward H. Angle, teacher (center); Frederick L. Stanton, Director of class and Secretary of the Angle School of Orthodontia; Milo Hellman; H. Leffler; Kihita Mataich.

Editorial

Hellman Memorial Meeting

A MEMORIAL Program in honor of Milo Hellman, D.D.S., Sc.D., was held on Tuesday morning, Nov. 11, 1947, the second day of the Annual Fall Meeting of the Northeastern Society of Orthodontists. When Dr. John W. Ross of Philadelphia, President of the Northeastern Society, opened the program, there were present members of Dr. Hellman's immediate family, many prominent New York City dentists, and a number of his former co-workers at the American Museum of Natural History, in addition to a record attendance of members and guests of the Society.

Dr. John V. Mershon, a classmate of Dr. Hellman at the Angle Postgraduate School of Orthodontia in 1908, presented "Personal Recollections of Milo Hellman," in which he called attention to Dr. Hellman's faculty, even in his early years, for singling out problems and deficiencies in orthodontics.

"Milo Hellman's Studies in Evolution and Variation of Teeth, Jaws, and Face" was the subject presented by Dr. William K. Gregory of the American Museum of Natural History, New York City. Professor Gregory, with whom Dr. Hellman worked and collaborated in the publication of many anthropologic papers, reviewed Dr. Hellman's widely accepted and highly significant contributions to anthropology, pointing out that Hellman not only introduced anthropometrics and cephalometrics to orthodontics, but that he in turn also made anthropologists more acquainted with their relationship to the underlying orthodontic problem.

In an extremely interesting paper on "Milo Hellman's Contribution to Physical Anthropology," Dr. Wilton M. Krogman, Professor of Physical Anthropology at the Graduate School of Medicine, University of Pennsylvania, reviewed Hellman's work in facial anthropometry. Professor Krogman's paper will do much to clarify further some of Hellman's most significant contributions in the field of facial anthropometrics, especially Hellman's views on individual variation and the expression of the individual normal. "According to Hellman," said Professor Krogman, "the pathway of normal growth and development was a broad highway on which the individual might perhaps deviate on the way, without actually leaving the broad pathway of normality."

Dr. Frederick B. Noyes, Chicago, Illinois, presented a paper, "Milo Hellman's Contribution to Orthodontics." Here again, Dr. Hellman's extremely critical approach was portrayed in the light of the empirical methods generally prevailing when Hellman began to point out the important role which growth and development play in orthodontic therapy. Hellman's cross-sectional work on skulls was presented by Dr. Noyes as the forerunner of more recent contributions in the field of facial development based on longitudinal studies of living children. Hellman's impatience with those who made a fetish of mechanics, according to Dr. Noyes, was due to the fact that he had steeped himself in the study of basic growth of children and realized that many of the, so-called, successfully treated cases were more the result of favorable growth than of the orthodontist's manipulative procedures.

Dr. Joseph D. Eby, who was largely instrumental in the arrangement of the program, in his personal tribute to the memory of Dr. Hellman, took occasion to introduce Mrs. Edith Hellman Bull, a daughter of Dr. Hellman, who had served as secretary to her father. She had materially assisted the Committee in the arrangement of the program, and assisted in editing and compiling her father's papers, so that they may be published posthumously.

Dr. Ralph Waldron, Chairman of the Necrology Committee of the Northeastern Society of Orthodontists, after reading an introductory biographical sketch of Dr. Hellman's life and works, presented the Resolutions of the Committee which were adopted by the Society. The solemnity and impressiveness of the occasion will live long in the memory of those present. This was a fitting, human memorial to the memory of one of the greatest minds in orthodontics.

J. A. Salzmann.

A Dedication

REALIZING keenly the great loss to the profession in the passing of Dr. Milo Hellman, it was most appropriate that the Northeastern Society of Orthodontists should devote part of their fall meeting to a Memorial Program in his honor. In like manner, it is most befitting that the *first* number of the AMERICAN JOURNAL OF ORTHODONTICS should be dedicated to his memory and be known as the *Milo Hellman Memorial Number.*

It is an interesting fact that at this time the growth of orthodontic science and practice has expanded to such an extent as now to be able to carry a journal of its own. It is the realization of a dream that has long been deep in the hearts of many of us, including Dr. Hellman. The knowledge of this fact would have been the source of a great deal of personal satisfaction to him.

The first article appearing in this issue, "The Future of Orthodontia: A Present-Day Problem for the Orthodontist," is a composite, consisting of a paper read before a meeting of the Eastern Association of Graduates of the Angle School in 1925, also one of similar nature which he read before the same Association in 1936. These two papers were never published individually. Interwoven with them is a paper entitled "Fundamental Principles and Expedient Compromises in Orthodontic Procedures," and an editorial entitled "The Crossroads," which appeared in the October, 1943, issue of the JOURNAL. This material has been carefully edited with sufficient explanatory notes to connect easily the continuity of thought for the reader. The conclusion contains some notes found on his desk which had been written the week before his death. They were the beginning of a topical outline for a paper which he had planned to write.

It seems significant that this trend of thought lingered in his mind over so many years and was brought out in his writings at these different intervals. It is hoped that this remarkable composite will be read with deep, abiding interest and that its influence will be widespread throughout future orthodontic progress. May it be accepted as the valedictory from one of the greatest minds ever devoted to the science and practice of orthodontics, and may it form a strong foundation for the structure the builders of that never-ending Tomorrow will erect.

The second paper appearing in this issue is a hitherto unpublished paper by Dr. Hellman entitled, "Some Conditions Not Favorable to Orthodontic Procedures." It has been selected for publication because of its significance and because, like the material of the first paper, it seems well worthy of profound study.

Following the papers presented at the Memorial Program of the Northeastern Society of Orthodontists appear the Resolutions of that Society, also those of the Eastern Association of Graduates of the Angle School, which Dr. Hellman loved so dearly and labored for so diligently.

Finally, there appears a priceless contribution which is herein enshrined with the hope and belief that it will remain a source of reference to all future students throughout the ages of progress in all those fields of science included among his research. This is an exhaustive bibliography which even to contemplate is quite amazing.

This *Milo Hellman Memorial Number,* and the *first* issue of the AMERICAN JOURNAL OF ORTHODONTICS, is hereby dedicated with the sincere affection of all who knew him and in recognition and appreciation of the benefits he has left to humanity.

The preparation of this material is the result of the efforts of many of Dr. Hellman's closest friends, and no request has been too great to be performed cheerfully and willingly. The feeling that has prevailed could be summed up in one thought: "so much has he done for us, how easy it is to do anything for him." Among those who have so generously responded to every request is Prof. William K. Gregory and those of his staff at the American Museum of Natural History, with whom Dr. Hellman labored and to whom he was deeply devoted. The advice, suggestion, and assistance of Dr. Bernhard W. Weinberger has also been most valuable. But the deepest acknowledgment of appreciation must be ascribed to Dr. Hellman's daughter, Mrs. Edith Hellman Bull. Having been raised in the atmosphere of her father, she not only developed many of his inherent characteristics but also, through the years of association with him both in his office and his research work, has become proficient in her father's heritage. Her part in editing the original articles was invaluable, and this remarkable bibliography is the result of countless hours of diligent work on her part. This has been done not only with skill and ability but with an inspired desire to do everything she could out of devotion to her father, to his friends, to his profession, and to the posterity he will continue to serve.

While death brought a conclusion to his personal activities, his memory will be cherished in the hearts of those who knew him as long as they live. The lifework of this great man, covering some of the critical decades of orthodontic progress, will live forever. So also shall his name and memory remain immortal.

Joseph D. Eby.

Milo Hellman

THIS first issue of the AMERICAN JOURNAL OF ORTHODONTICS is dedicated to the memory of one of orthodontics' most highly respected workers and scientific minds. The late Milo Hellman of New York was another one of the

pioneers of the specialty, which started about the beginning of the century. He was one of the teachers in its early days, and to say that he left a permanent indentation on the specialty as a result of the orthodontic record of his lifetime is to put it mildly.

He probably established the all-time record in lifting both his voice and pen in opposition to what he regarded as an overmechanical or gadget concept that was so characteristic of orthodontics during its early, formative years.

Early in his career, Dr. Hellman observed that if orthodontics were to be established even as an applied science, its workers first must recognize the fundamental fact and principle that treatment is essentially a biologic problem. It was this idea that drove him to delve into collateral sciences for information and help. This brought him into close working cooperation with the well-known scientists, such as Gregory and Osborn. Together they studied the origin and evolution of the human molar teeth and many other subjects that he hoped to tie in with the orthodontic problem in order to contribute more basic foundation to the subject.

Hellman was the first to bring to the minds of orthodontists the significance of normal variability and its recognition in practice. He tried to find ways and means to apply this fact in everyday practice.

A checkup reveals that the first article by Hellman to be published in the former INTERNATIONAL JOURNAL OF ORTHODONTIA was in 1917; subsequently through the years, including 1941, twenty-four of his articles appeared in this JOURNAL alone. He has contributed numerous scientific articles to many other medical and dental periodicals in both America and abroad.

Because Dr. Hellman made some of the finest contributions to the specialty during its entire history, the editorial board of the AMERICAN JOURNAL OF ORTHODONTICS decided to dedicate a memorial issue to him. The JOURNAL is proud and happy to dedicate this issue to the memory of one of orthodontics' greatest teachers and original researchers.

Many of the men who put their enthusiasm, time, and money behind the infant specialty, orthodontics, have died—Angle, Case, Ketcham, Dewey, Young, Hawley, Kelsay, Stanton, Baker, and others. Now they are joined by another whose life helped write orthodontic history during the present century.

Dr. Hellman was one of the early editors of the *American Orthodontist*, the first journal ever published and devoted exclusively to orthodontics.

Orthodontics, now and in the future, will revere the memory of Milo Hellman, author, researcher, practitioner, and a modest, personable, jovial man, respected by all who knew him. He was probably the most prolific contributor to orthodontic science for all time.

The AMERICAN JOURNAL OF ORTHODONTICS, its editorial staff, and readers are deeply indebted to a group of workers, members of the Northeastern Association of Orthodontists, who burned the midnight oil to help prepare the *Milo Hellman Memorial Number*. This group was led by Dr. Joseph D. Eby, who, along with several tireless helpers, proofread and edited much of the posthumous manuscript of the late Milo Hellman.

H. C. P.

Department of Orthodontic Abstracts and Reviews

Edited by

Dr. J. A. Salzmann, New York City

All communications concerning further information about abstracted material and the acceptance of articles or books for consideration in this department should be addressed to Dr. J. A. Salzmann, 654 Madison Avenue, New York City

The Primary Dentition in Homo Sapiens and the Search for Primitive Features: By Hector G. Jones, Toowoomaba, Queensland, Australia, Am. J. Phys. Anthropol. Vol. 5, N.S., 251-282, September, 1947.

Many authorities are convinced that interlocking canines characterized the dentition of the primitive ancestral type of early man. So far, the only possible appearance of such a feature has been in Piltdown, and here there is no real certainty. In the apes and the other families of primates, we see interlocking canines of varied size and shape. In the males they are larger than in the females. In the chimpanzee, the canines are relatively smaller than in the other apes and lower families, so that many physical anthropologists have learned to look for a remote human ancestor displaying relatively larger canines than exist today, with a diastema in the maxilla.

The writer suggests that in forming some conception as to what we may reasonably expect in the earliest human forms, we should look not so much for interlocking canines of the anthropoid type, as canines having the relative dimensions and, in particular, the occlusal relationships which are so often to be seen in the primary dentition. The deciduous teeth are formed long before eruption, even before birth, and it surely is quite a likely assumption that the primary dentition displays a greater resemblance to the primitive secondary than does the human secondary dentition of today.

Gregory, in deprecating any such line as a general principle, points out that in physiologic processes the course of development is fundamentally anticipatory rather than reminiscent in character, because the most pressing business of the embryo is to provide the ground plan for an adult of its own species. Yet it is a fundamental principle of evolution that the development of the human embryo discloses the many links with other forms of life.

We propose to assume that characters which are observable in the primary dentition are not merely attributes of that dentition but may record primitive characters, which have long since been lost to the secondary dentition.

MESIODISTAL MEASUREMENTS

In Keith's *New Discoveries Relating to the Antiquity of Man,* where he is discussing the dentition of Australopithecus, we find the following table of mesiodistal tooth measurements (in man):

	MILK DENTITION			PERMANENT MOLARS				
	I^1	I^2	C	M^1	M^2	M^1	M^2	M^3
Gorilla	7.5	6.5	9.5	9.0	10.5	14.6	15.2	14.1
Orang	10.5	8.0	10.5	8.5	11.5	11.7	12.0	10.0
Australopithecus	5.2	4.5	6.5	9.2	10.0	13.0		
Chimpanzee	8.6	6.5	8.0	6.0	9.5	10.0	10.2	9.0
Man	7.1	5.0	5.3	6.8	7.5	10.7	9.2	8.5

The writer has made examinations of a number of children (European), and the figures obtained do not accord with those given by Keith for man. It will be observed that in the mesiodistal diameters, that given for the second deciduous molar is slightly more than that for the central incisor, and that the lateral incisor, the canine, and the first deciduous molar all have a smaller mesiodistal diameter than the central incisor.

This is not the writer's experience, and he feels that an error of some kind has crept into the figures cited. The measurements obtained by the writer accord very well with those contained in Black's *Dental Anatomy*.

In order to estimate the extent of the diminution of the canine which seems to be apparent in man as compared with the anthropoids, the writer measured the primary dentition of a number of children and the secondary dentition of a number of adults. The figures were in each case dimensioned to the arbitrary figure of 100, which was allotted to the central incisor. The measurements given by Black were similarly treated.

In the teeth under consideration, Black's figures give the same result as those obtained by the writer, and it is clear that relatively the deciduous canine is quite substantially larger mesiodistally than its permanent successor.

It is with the canine figure only that we are concerned, and two features at once strike us:

1. The likeness between gorilla and Australopithecus, extending to the lateral incisor also.
2. Orang and chimpanzee are much closer to man in this comparison.

LABIOLINGUAL MEASUREMENTS

If we contrast the labiolingual measurements of the human deciduous dentition with those of the permanent dentition, using Black's figures, we see that the deciduous canines are very different from the permanent canines. We may look for an apelike or prehuman ancestral being in which the canines would be relatively larger mesiodistally and labiolingually, in comparison with the incisor teeth, than are to be seen today, and would bear a somewhat similar ratio to the permanent incisors to that the deciduous canines bear to the deciduous incisors.

Man differs from other primates in modes of mastication. Despite the fact that in man the glenoid fossa is basically deeper than in other primates, there is more range of lateral movement in the excursions of the mandible. Briefly, the mandible is thrust laterally so that the buccal cusps of the lower posterior teeth occlude with the lateral border of the buccal cusps of the maxillary teeth on that side. The temporal, masseter, and internal pterygoid muscles then crush the occluding teeth together, and at the same time the mandible moves medially and slightly upward to the position of centric occlusion. On the opposite side, the teeth do not make contact until just before centric occlusion. Mastication is from lateral to medial, and is unilateral, the teeth of the opposite side being definitely not in contact. The food bolus is, by means of the tongue and teeth, kept on that side only where the shearing stresses are taking place.

There are certain fundamental differences between man and ape in the mode of function of the dental machine, which have not been made fully clear in current literature. In order to investigate these differences, the writer made a motion picture of a rhesus monkey having a meal, and of a European with an excellent natural dentition reproducing the movements of mastication. In the case of the European, the movements were recorded with the lips open and also with the lips closed. This film demonstrates quite clearly the differences in the mandibular movements of mastication between man and the other primates. With the monkey there are certainly no lateral excursions of the mandible,

movement being practically straight up and down. If there is any lateral movement, it is very slight and almost negligible. Comparison of anatomical specimens will prove that monkeys and anthropoid apes are very different from man in the movements of the masticatory machinery, and the difference can all be laid at the door of the canines. These practically prevent lateral movement of the mandible. A slight lateral movement may be attained after many years, but this is strictly limited and can only result after heavy attrition.

The photographic reproductions of the maxillary and mandibular teeth of the gorilla will indicate that the buccal cusps of the maxilla and the lingual cusps of the mandible are not worn to any degree comparable with their fellows. The main area of occlusion is gouged out of the teeth to a very noticeable depth, and clearly proves the assertions made earlier.

Should we compare the dentition of the apes and monkeys with the dentition of the Australian aboriginal, we cannot but be forcibly impressed by the fact that under attrition, the cusps of the human teeth are completely worn away and present a flat surface. Now it is a different condition that we see in the anthropoid, in which the buccal cusp formation of the teeth tends to persist even when attrition is marked, proving that there is practically an absence of the shearing component of mastication.

This difference between man and the other primates is of supreme importance, being fundamental. Since the cusp formation, which exists at tooth eruption, tends to persist much longer under attrition in the anthropoid, we should be justified in assuming that the mode of mastication and the mandibular movements seen in them are the more primitive. Man alone of the primates has learned to incorporate the shearing stress into his masticatory apparatus. The result is that in the primitive state, living on rough fare, he suffers rapid occlusal attrition, the cusps being shorn completely away quite early in adult life. To put it another way, man has tended to adopt in this regard the mode of mastication of the ruminants, without possessing any form of compensatory mechanism, such as Nature has provided him with, to meet this factor. The attritional wear seen in such fossil types as Rhodesian man, Neanderthal man, and Sinanthropus is exactly such as we have described for modern man.

The vertical masticatory movement of the mandible in apes, caused primarily, as we have seen, by the large canines, has a particular effect on them. Attritional wear tends to keep them sharp. The lower canine is accommodated between the distal of the lower canine and the mesial slope of the first lower premolar, but not so much into a diastema as into the V-shaped space formed by these two teeth, at the same time overlapping them to some degree.

Let us now examine the canines of the temporary dentition in order to see if any vestige of a similar condition can be seen. The features therein described are not universal, but are quite common, and the writer has observed a considerable number of similar cases. The mandibular cast shows the areas where the maxillary teeth occlude with the lower teeth. The models were held in occlusion and the right mandibular teeth below the line of occlusion were heavily penciled.

Examination of the models discloses a noteworthy feature. It will be observed that in central occlusion, the distal slope of the lower canine makes contact with the mesial slope of the upper canine and that this tends to keep the canine tips sharp. This the writer believes to be a most important survival of a primitive condition, and is a somewhat similar condition fundamentally to that shown in the canines of the gorilla. This is the means adopted by nature to keep the canines—a weapon of offense—in a proper condition. The canines obviously are relatively large mesiodistally; they project beyond their incisor

companions, and to a slighter extent beyond the occlusal surfaces of the molars. Examining the models and testing the lateral movement of the lower indicates that the upper canine has a decided interlocking action.

THE EDGE-TO-EDGE BITE

Should it be pointed out that the edge-to-edge bite does not exist in the models, and that on that score the claim for primitive features in the canines must be queried, the writer would reply that he is not at all convinced that the edge-to-edge bite, as seen in Australians and other primitive types of man, is necessarily a primitive feature.

Campbell has proved that the human edge-to-edge bite is not manifest during the eruption of the permanent teeth. Campbell asserts that:

"The edge-to-edge bite, said to be typical of the Australian dentition, was one which, though present in the adult almost without exception, was a modification only acquired by the attaining of adult age."

In searching for the cause of the aboriginal edge-to-edge bite, Campbell observes: "In any series of Australian skulls which include sufficient specimens of varying ages, it can be seen that the presence of the edge-to-edge (bite) is associated with the occlusal wear the teeth have undergone; that is, a diminution in the cusp height of molars and premolars is accompanied by an apparent shifting forward of the lower anterior teeth relative to the upper anterior."

The practice of prosthetic dentistry will disclose the underlying truth of Campbell's contentions. Any prosthetist knows that in the construction of full upper and lower dentures, "closing the bite" after setting up the teeth demands that the lower anteriors be set up in a more posterior position, or that the upper anteriors be moved forward. The converse requirements of "opening the bite" disclose the conception better, as, if the bite be opened, it will be readily observed that the lower anteriors appear to have moved backward as well as downward, in relation to the upper anteriors. In our professional duties we frequently observe that clients who have been wearing the same artificial dentures for many years have experienced much alveolar resorption, and that the lower anterior teeth which once were set within the upper anterior teeth have come to occupy a position in front of the upper incisors. This would seem to bear out Campbell's contentions.

Campbell, however, does not feel that this is a complete explanation of the feature. His research has indicated to him that although occlusal wear has apparently brought the lower anterior teeth forward, the lower molar teeth still occupy the same relative position with regard to the maxillary molars. "Therefore," he says, "it seems as if we must consider the main change as having occurred in the anterior region of the arches. It seems that the condition must be brought about by some change in the relative positions of the anterior teeth in the two (2) arches." His later research indicates that a probable factor is "a widening of the arch in the canine-premolar region."

The writer suggests a factor which seems to him to be fundamentally connected with the acquisition of the edge-to-edge bite, and is possibly a complete explanation of every phase of this characteristic. Primitive man needed powerful incision for the dismemberment of tough food, in particular, meat, which played so large a part in the aboriginal diet. Meat held firmly in the incisor teeth was dragged forward by hand and in this manner divided. Against the force forward and slightly downward imparted by the hand, a corresponding force backward must be applied by the mandible, so that the anterior teeth of the mandible would tend to move slightly forward as a result of this applied force.

Now "depression" is a regular part of the repertoire of the orthodontist, and teeth may be depressed as desired, where it is considered advisable to move a tooth into its alveolus to some extent from its original position. The surrounding bony structure, the periosteal attachment, or periodontal membrane, and the gingival tissues accommodate themselves to the new position quite normally; so that in any primitive state where continual use of the incisor teeth is a regular feature, the writer feels that the combination of forces described leads to the lower anterior teeth being drawn slightly forward, and at the same time depressed until the posterior teeth come into occlusion together with the anteriors. The dental machine in the primitive state is then complete.

The writer claims that the resemblance between the edge-to-edge bite of man and that of the anthropoid apes is more apparent than real. In anthropoid apes and catarrhine monkeys, movement is practically up and down, so that the anterior teeth must occlude in the same mandibular position, as otherwise incision would be impossible.

The same feature is to be seen in the primary dentition of the apes, the bite being of the same edge-to-edge type that is evident in their seecondary dentition. The canines are interlocking, but not on the same scale as in the permanent dentition. In the baby chimpanzee the bite is absolutely edge-to-edge; in the orang, although the upper central incisors overlap the lowers ever so little, the bite is to all intents and purposes edge-to-edge.

The edge-to-edge relationship in the adult Australian aboriginal is really of a somewhat different order from that of the other primates. First, there is not entire uniformity in the relationship of the lower anteriors to the uppers; in some, the uppers are to a slight extent anterior to the lowers; in others the anterior surface of the crowns of the uppers is continuous with those of the lowers. The bite is edge-to-edge, with a few exceptions; but in some it is only just edge-to-edge, while others occupy various positions between this stage and the absolutely edge-to-edge relationship. Secondly, in the Australian, the canines reduced in size, perhaps as a result of Keith's "evolutionary bias" are relegated in function to the position of incisor teeth, and, owing to this, a heavy shearing stress can be obtained by moving the incisor teeth laterally.

The Australian edge-to-edge bite is the result of tearing tough and coarse foods, meat in particular, by means of the anterior teeth. If this were not so, we should expect aboriginals born in the Mission Stations to have an edge-to-edge bite, as an inherited trait, in spite of a European diet. This is most definitely not the case. The writer has examined a number of aboriginals in Mission Stations, and the relationships of the anterior maxillary and mandibular teeth are exactly as in our British race in this continent. There is not a trace of edge-to-edge bite, and the overbite can be very pronounced.

Examination of the very few pure aboriginal children in the Mission Stations, all of these being about 10 years old, discloses the truth of Campbell's findings with regard to the overbite relationship. There is not the slightest trace of any condition different from that seen in our British children.

Surely no further proof is required that the Australian aboriginal in the relationship of his anterior teeth does not differ in any material regard from the European. Quite obviously he inherits no edge-to-edge bite as do the other primates. The writer believes that if a European child could be reared under primitive conditions with Australian aboriginals completely remote from European influence, he would develop in the anterior teeth the same edge-to-edge bite.

THE DIASTEMA

Linked with the search for human interlocking canines is the expectation of finding a fossil human dental arcade with maxillary diastemata to accommodate

the mandibular canines. The literature pertaining to the teeth of fossil man indicates the general expectation that some such condition is considered to belong to the ancestral human form at some remote period. Not yet have the expectations been realized. If the edifice of Smith, Woodward, and Keith be correct, Piltdown man in all probability had maxillary diastemata, but this is, after all, only assumption, in the light of our present knowledge.

Weidenreich makes reference to the general search for the diastema in his discussion of the features of the Sinanthropus dentition as follows:

"In the chapter dealing with the canine problem, the question had already been raised whether the presence of a diastema can be taken to be an indication of there having existed originally a large canine in a preceding stage of human evolution. Within this chapter it was shown that a diastema had not been present in the lower dentition of Sinanthropus, but what the conditions were in the upper jaw could not be ascertained, due to lack of material. Since the writing of that statement, the upper jaw of Locus O I was found, which demonstrates that there is not the slightest indication of the presence of a diastema. Nevertheless, as has already been pointed out, it is impossible to draw any conclusions with regard to the conditions of canines in preceding stages, for even in recent anthropoids, diastemata in upper and lower jaws may be completely absent, despite the really tusk-like canines. The fact that such an occurrence is rather common, especially in orang, is proved by Selenka's (1898-99) statement. He found that in the upper jaws of female orangs a diastema was missing in 30 per cent and in lower jaws in 34 per cent. The percentage derived for the male orang is smaller, but nevertheless was found to be missing in 18 per cent."

The quotation is given at length since Weidenreich is clearly minimizing the value of a diastema as an ancestral trait. He stresses the fact that in quite a substantial percentage of anthropoids there is no diastema even in the maxilla. In the limited number of ape crania that the writer has had the opportunity of handling, not one was without a marked maxillary diastema. The cooperation by letter of the museums in Sydney, Melbourne, and Adelaide was enlisted in testing the truth of the statement attributed to Selenka.

Turning our attention once more to the examination of the human primary dentition, in order to see if there is any indication of a diastema which may serve as a guide in the search for such a primitive feature, let us examine the models which we have already found helpful and instructive in the discussion on canines.

There can be not the slightest doubt that on both sides of the casts presented there is a maxillary diastema for accommodating the lower canines. On the left side this diastema is 1.9 mm. mesiodistally, on the right, 1.8 mm. These diastemata obviously are associated with the mode of occlusion of the upper and lower canines. The combination of features here, though not identical with the simian condition, is obviously somewhat akin. Nor are these diastemata as large as can be seen in other youthful patients who present themselves at times.

There will yet be found in fossil form a primate ancestor of man with a permanent dentition containing relatively much larger canines than are seen today, similar to those of the deciduous dentition in shape and mode of occlusion, fitting into diastemata of the same type. At least, certain intermediate stages should present themselves.

Before leaving the discussion on canines and diastemata and the evidence of primary dentition, we must note one very fundamental difference between man and the anthropoid apes. In the former, the secondary canines are relatively smaller than the primary canines; in the latter they are relatively larger.

Last, brief reference must be made to the fossil "man-apes" of South Africa. Gregory and Hellman (1939) had just completed their work on the teeth of these

forms when the work described in these pages was being finalized. Since then it has been my privilege to receive some beautiful casts from Dr. Broom (Transvaal Museum, Pretoria, South Africa) of the dental tissues and surrounding bony structures of Plesianthropus and Paranthropus and they are undoubtedly an astonishing combination of features. Dr. Broom was also good enough to send the May and June Issues of the *Annals of the Transvaal Museum* (1939). The former contains Dr. Broom's description of the dentition of Pleasianthropus and Paranthropus, the latter, the work of Gregory and Hellman on these primates.

The upper canine "is actually smaller in its transverse diameter than the first premolar, whereas, even in female apes, it is normally larger than that tooth. Moreover, its crown, although somewhat worn off at the tip, is not dagger-like as it is in typical modern female apes, but altogether more like a human canine."

There is not the slightest trace of a diastema, and the strong similarity in certain regards to the human dentition is obvious from the illustration.

Gregory and Hellman state that Plesianthropus presented such an astonishing mixture of ape and human characters, that for a long time they were in doubt whether to call it a very progressive ape or a very primitive man. The conclusion drawn by these scientists is that the South African Pleistocene manapes were in both a structural and a genetic sense the conservative cousins of the contemporary human branch.

This finding in no sense militates against the writer's convictions concerning the ancestral canines. But it does indicate that the older acceptance of the anthropoid ape type as the ancestral human form has been rather too rigid in its application.

THE FIRST DECIDUOUS MOLARS

Many years ago, in removing the maxillary teeth from a patient, it was observed that all four premolars had one lingual and two buccal roots. Most unfortunately, any possible significance of this phenomenon was lost at the time. Hrdlička has stated that "The crown of the human tooth even in its minute details represents but little that is fortuitous. It is the resultant of inherited ancestral conditions, modifying further by evolution and involution."

Whether this be true or not, it does seem a remarkable coincidence that a condition apparently resembling the anthropoids in all four maxillary premolars should have existed in a modern European. Dr. Campbell of Adelaide, in a private letter, states that this phenomenon is not really rare.

Human first premolars in the maxilla have two roots, and second premolars one root, as is well known. The upper premolars of the anthropoid apes all have three roots, two buccal and one lingual, as in the molars.

What are we to look for in the upper premolars area as indicating an ancestral human condition? Examination of the first deciduous molar and of the first permanent premolar of the anthropoids discloses less difference superficially than exists between the corresponding human teeth. The teeth which are called deciduous first molars are really a specialized form of tooth of a premolar type.

When a human maxillary deciduous first molar is viewed from the buccal side, the crown has its greatest gingivo-occlusal height over the anterior buccal root. The first permanent premolar in the apes has exactly the same appearance. It is evident too in the lateral view of the Dryopithecus maxillary dentition.

Black states that the deciduous first upper molar has three lobes or cusps: mesiobuccal, distobuccal, and mesiolingual, and three grooves: buccal, lingual, and distal. He considers that in their form and cusp design they are peculiar to themselves. Careful examination of the occlusal surface of a human upper deciduous first molar discloses the condition described below. This is illustrated by diagrams made from photographic enlargements of two different teeth, and,

in order to accentuate the features, the occlusal surface was penciled in such a manner that the depressions remained unmarked. The diagrams are intended to display clearly the features as they are seen by the writer.

The protocone, paracone, and metacone are quite apparent, bounded by an equally diminutive distolingual groove. From the central pit, the mesial groove runs forward. The buccal groove runs laterally and the distal groove posteriorly, passing over the oblique ridge which connects the protocone and the metacone in any normal upper molar. The mesiobuccal triangular groove (anterior fovea) running from the mesial end of the mesial groove is quite clear. The distolingual groove is diminutive and clearly outlined.

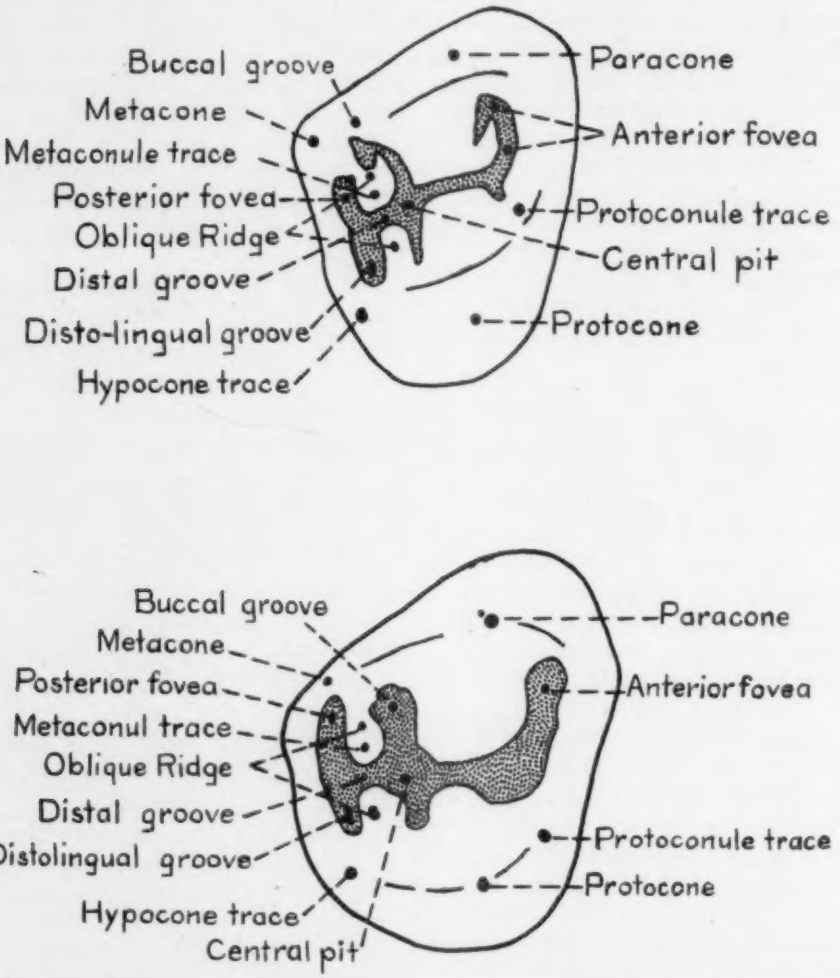


Fig. 1.—Diagrams of the occlusal surfaces of two human upper deciduous first molars.

Our study of the occlusal surface throws light on the premolars. We discern only a small metacone, and a diminutive vestigial trace of the hypocone. Again the mesial groove, the buccal groove, and its slight lingual prolongation, and the anterior fovea clearly display the general outline of the occlusal grooves of the upper premolars.

Of this there can surely be no doubt. We might perhaps infer that the distobuccal root has vanished along with the metacone and hypocone. If these

deductions be sound, the human first premolar preserves the mesiobuccal and the lingual roots. In the anthropoid apes all three roots remain, this presumably being the more primitive condition.

Let us now examine the occlusal surface of an upper second premolar which has been penciled in the manner described earlier.

The fissures or grooves show up clearly and the diagram based on photographic illustration is most interesting. They are found to be very similar to the pattern of the deciduous first molar depicted earlier. From the central pit, the mesial groove runs forward and turns labially to become the anterior fovea. The buccal groove runs from the central pit but soon loses itself. The small ridge behind is what remains of the oblique ridge connecting the metacone and protocone. This is cut by what represents the distal groove in the normal molar pattern. Behind this lies a small lingual groove, the buccal end of which is what remains of the posterior fovea, the groove itself being representative of the distolingual groove. There seems to be no trace of a hypocone element.

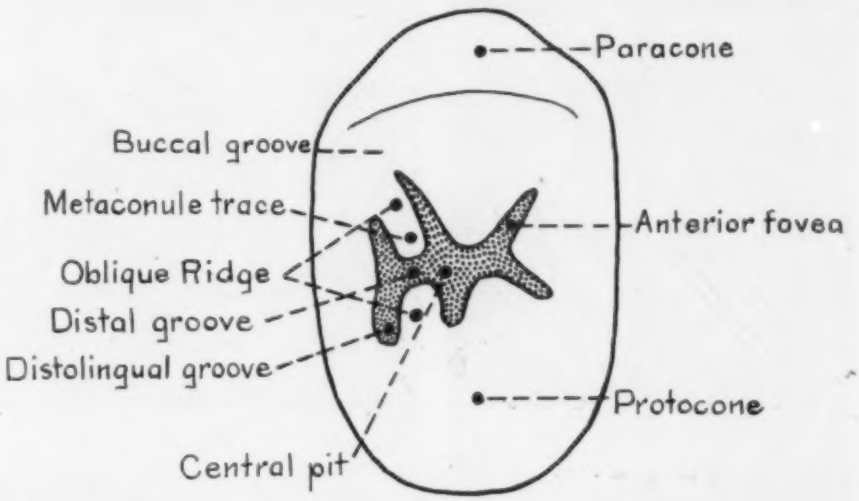


Fig. 2.—Diagram of the occlusal surface of a human upper second premolar.

In order to see these features it is necessary to pencil the occlusal, and the tooth must be undamaged on this surface. Opportunities are not very frequent for examination, as sound teeth are not often extracted. Again, the appearance is not uniform by any means, but although the writer has expected to find in a first premolar the appearance described, his search has so far failed. In the second premolars, he finds it so frequent as to be commonplace. The fact that the resemblance which has been described exists at all is submitted as a phenomenon worthy of further investigation.

Black, Gregory, and others seem to be unanimous in regarding the upper deciduous second molar as a facsimile of the upper permanent first molar. Superficially, the resemblance may seem to be perfect, but certain important differences manifest themselves after suitable specimens are carefully examined.

The upper deciduous second molars are quite often a perfect example of the Dryopithecus molar pattern. The features may be briefly set out as follows:

1. The cusps are high.
2. The grooves or fissures are deep.
3. The protoconule and the metaconule are more clearly differentiated.
4. Carabelli pits are frequent.

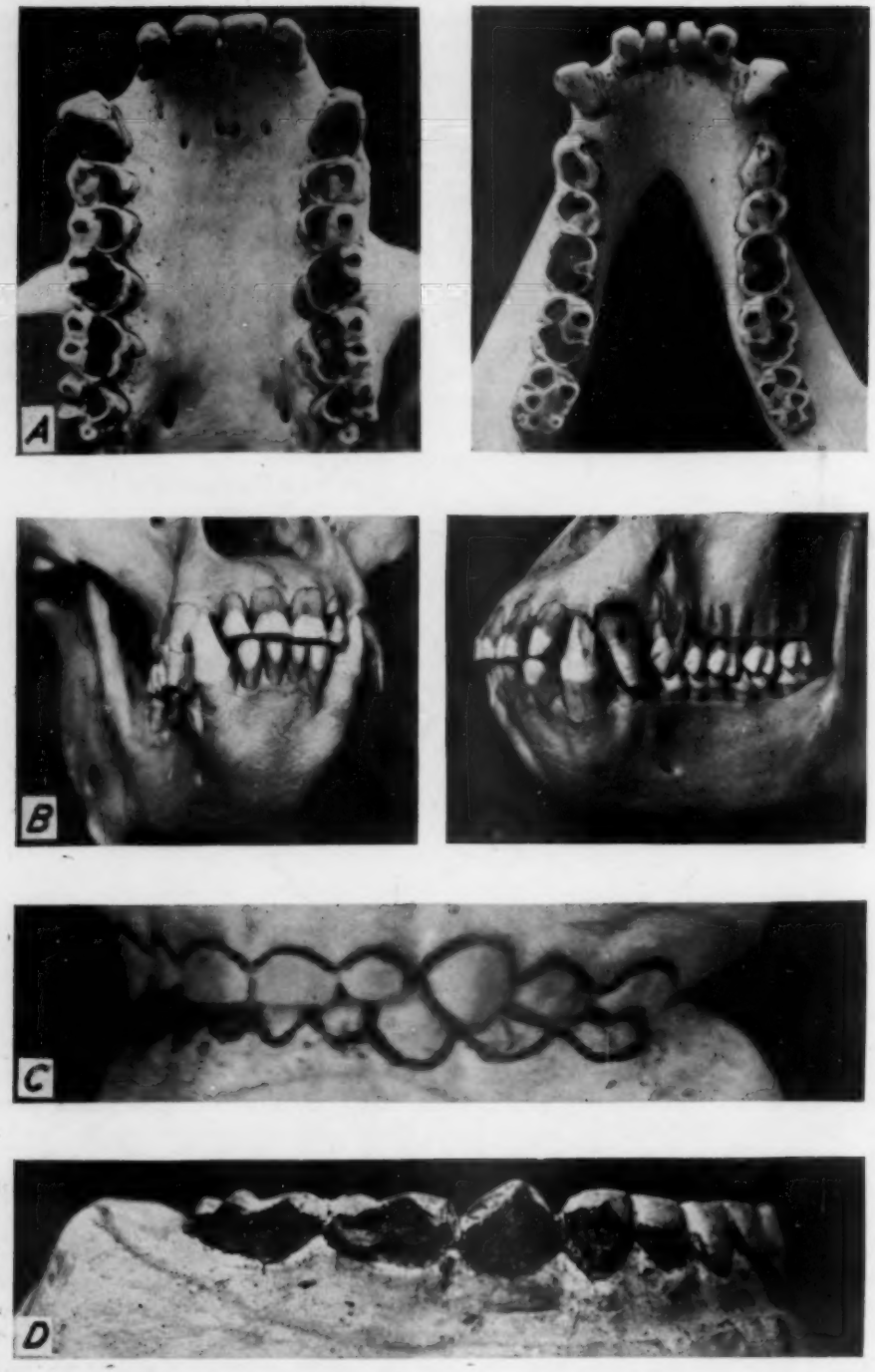


Plate 1.—Explanation of figures: *A*, Maxillary and mandibular dental arcades of a gorilla, showing characteristic wear. *B*, Front and side views of the jaws of a male gorilla showing worn anterior teeth with the posterior teeth retaining their cusps. *C-D*, Models of the temporary dentition of a white child, 4 years old. Unshaded parts of mandibular teeth in *D* show where the maxillary teeth occlude.

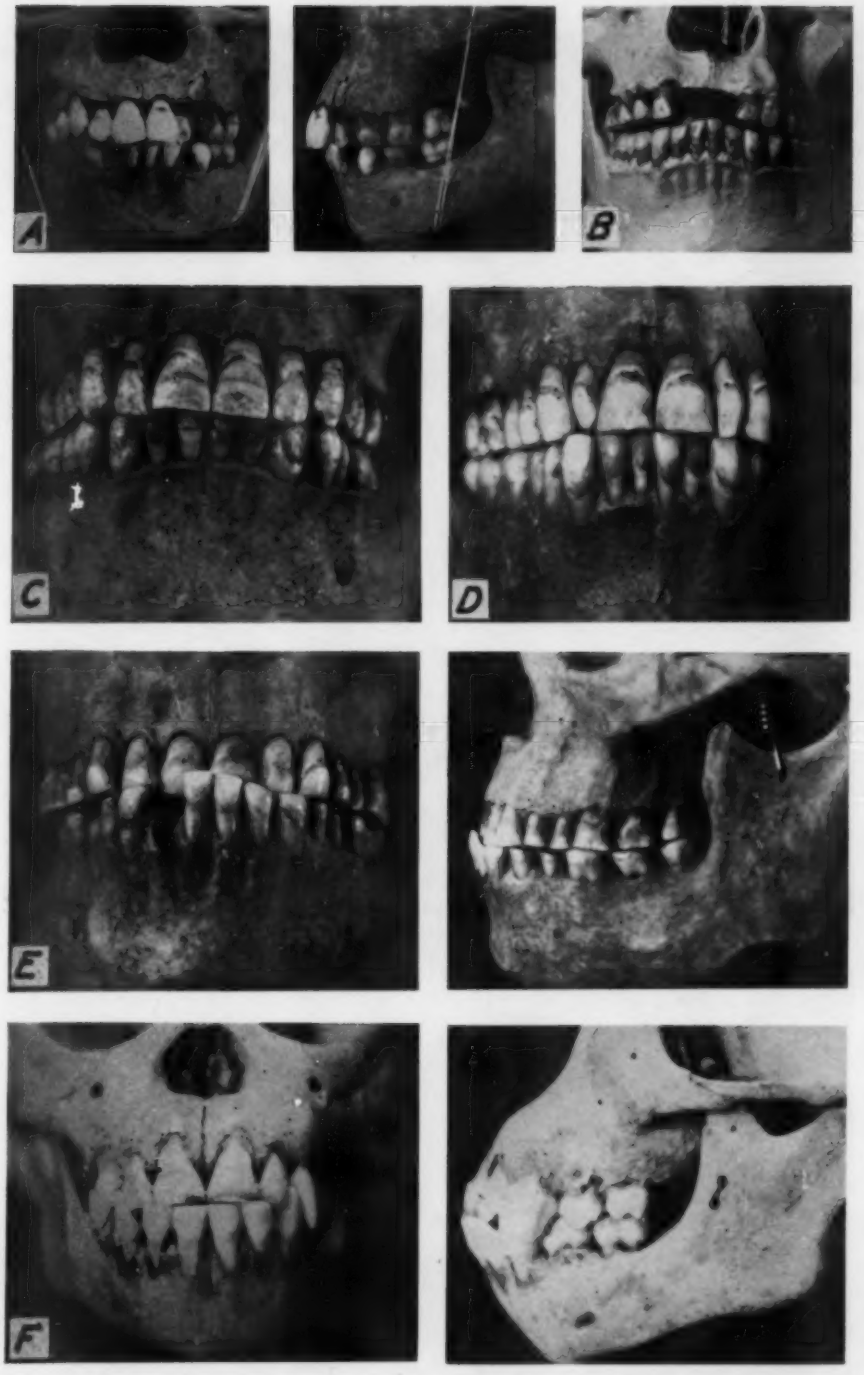


Plate 2.—Explanation of figures: *A*, Two views of the jaws of an aboriginal Australian child with overbite. *B-E*, Views of the jaws of four adult aboriginal Australians. In *B* there has been ablation of the upper incisors; in *C* there is a definite overbite of the upper anterior teeth; in *D* there is a slight overbite; and in *E* there is an uncommon relationship between the anterior teeth with marked wear of the posterior teeth. *F*, Two views of the jaws of a baby chimpanzee showing edge-to-edge bite.

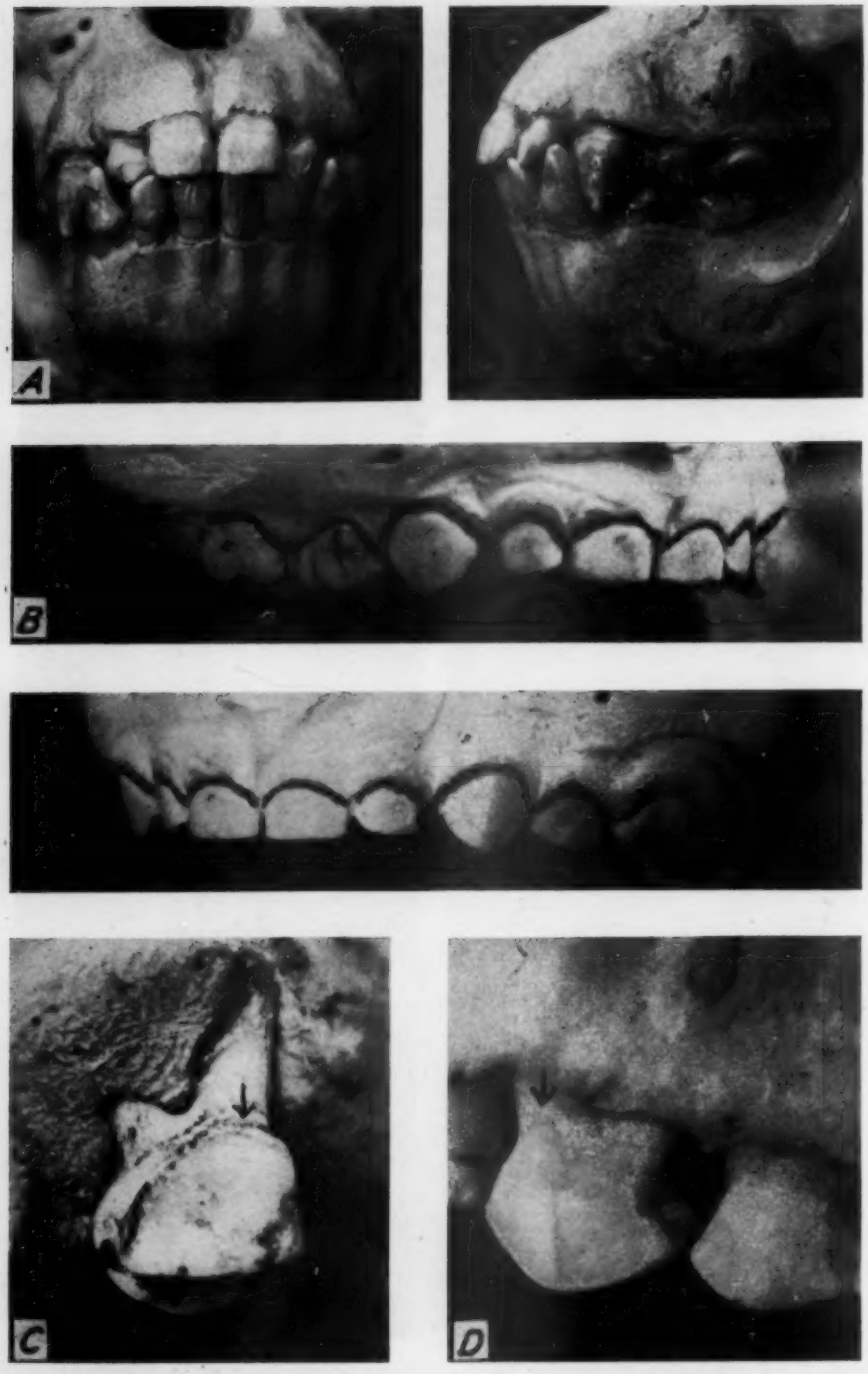
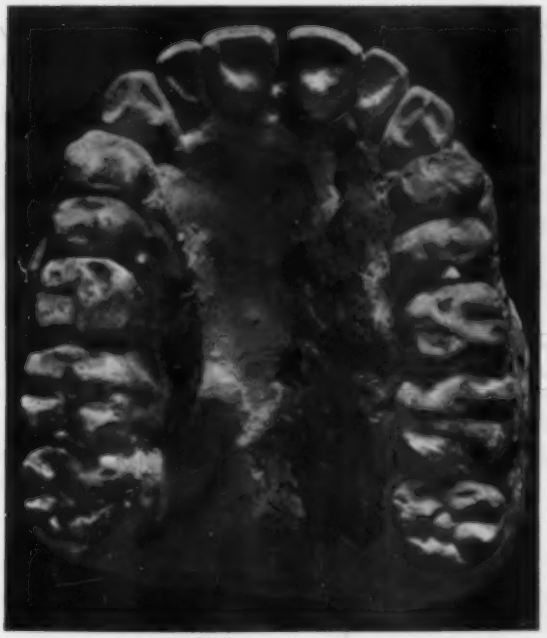


Plate 3.—Explanation of figures: *A*, Two views of the jaws of a baby orang with oblique overlapping central incisors. *B*, Two views of same model shown in Plate 1, *C*, illustrating diastemata in a human primary dentition. *C*, Buccal view of a human maxillary deciduous first molar. *D*, Buccal view of maxillary permanent first premolar of a gorilla.



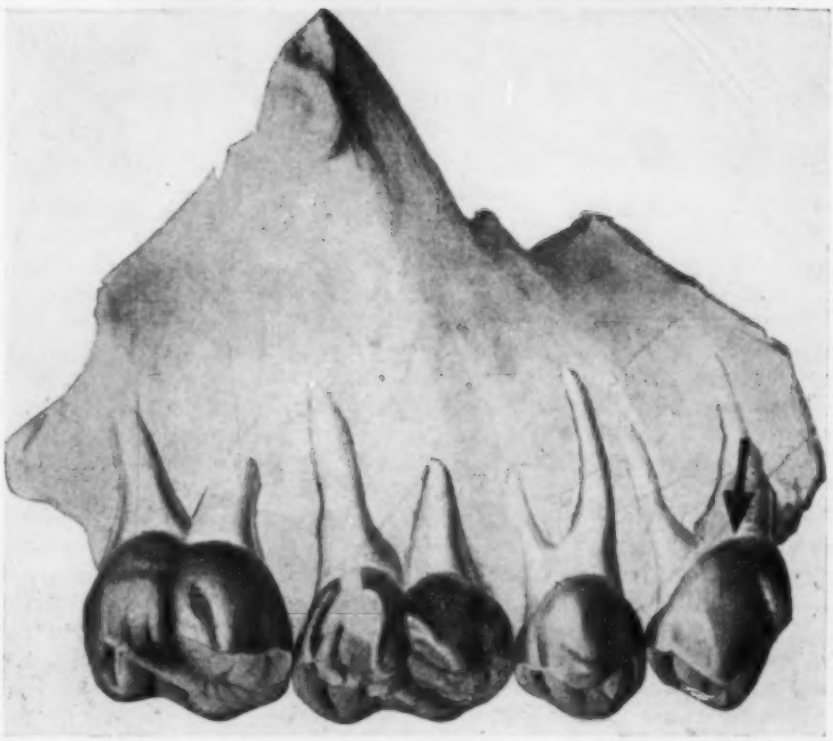


Plate 4.—Explanation of figures: Above, Upper dental arch of Plesianthropus transvaalensis (Gregory and Hellman, 1939, Fig. 5, *B*). Below: Lateral view of the Dryopithecus maxillary dentition (Gregory and Hellman, 1926, Fig. 8 [2], after Pilgrim).

The first and second features are all important, for one essential difference in the crowns of the anthropoid permanent molars, as compared with those of man, is the greater height of the cusps and consequently greater depth of the grooves and pits. There can be no doubt that in the apes this condition is associated with a form of mastication practically straight up and down.

The third feature is one to which Gregory and Hellman call attention as a feature of primitive primate molar occlusal area, and many human upper deciduous second molars display these two small-crested cusps.

No less interesting is the situation disclosed by a study of the other deciduous molars. Features can be verified easily, and are full of interest. First, the upper deciduous first molar of the orang is much more like the corresponding human tooth than is that of the chimpanzee. And yet the chimpanzee is generally accepted as showing the greatest affinities with man. Secondly, the upper deciduous second molar of the orang is less sectorial in appearance than the corresponding human tooth. Thirdly, the resemblance between the human lower deciduous first molar and the lower permanent second premolar of a female gorilla is quite astonishing, and recalls the fundamental similarity in the occlusal surface of the human maxillary deciduous first molar and the human maxillary permanent second premolar, attention to which was drawn in a preceding section.

News and Notes

Important Information Concerning the American Association of Orthodontists' Meeting in Columbus, Ohio, April 26, 27, 28, and 29, 1948

The past decade, because of the war, has been one of interference and confusion in professional life. Even so, the number of practicing orthodontists has continued to increase tremendously. It is our opinion that the American Association of Orthodontists is an organization well fitted to provide the opportunity for this group to refresh itself as to rational orthodontic procedures and that the usual bringing together of disconneced papers does not seem at this time to answer that purpose.

We have, therefore, arranged what we term a coordinated program effort, wherein each paper is closely connected with the preceding one. The papers will be presented in a sequence comparable to the procedures we follow as we make plans to start and carry through to completion the treatment of an orthodontic patient.

Deshler-Wallick Hotel

Neil House

Our first contact is consultation; our first paper is a discussion of *"The Consultative Period."* Diagnosis logically follows, wherein we consider the *"Type of Case,"* and our second paper is on that subject. However, at times we can provide advice which may prevent or lessen the need for actual treatment, and it is, therefore, proper at this point to include a paper on *"The Prevention and Interception of Malocclusion."* During our detailed analysis of the prospective patient, there arises the question of etiology. We have arranged four papers to deal with that broad and complex field. The first, *"Oral and Environmental Conditions"*; the second, *"Radiographic Analysis"*; the third, *"General and Facial Development"*; the fourth *"Psychological and Hereditary Factors."*

If, after full consideration of all the problems incident to the case up to this point, we think that actual therapy is advisable, we would have to consider *"Time as a Factor in Treatment Planning,"* and give thought to *"The Tissues Involved and the Changes Which Occur in Them"* due to corrective measures. Our knowledge of *"The Fundamentals of Anchorage, Force, and Movement"* permits us to choose suitable technical procedures and use them according to our individual peculiarities. *Treatment Planning* is offered with reports of treated cases through corrective measures. Near the close of treatment, we are faced with the problem of support for the improvement we have obtained, and consideration of *"Retention"* is essential.

The above is the lecture program for this meeting—in reality, an outline of what transpires during "the passage of a patient through an orthodontist's office." We have in this manner considered in an orderly sequence and in considerable detail the problems which are ours as we seek to provide a beneficial service to the children of America.

The clinics on Thursday afternoon will be of a nature to supplement much of the lecture program and are of a character highly creditable to the orthodontic specialty.

If you have not done so, please make your hotel reservations immediately. The reservations are far ahead of expectations. We do not want you to be inconvenienced.

Neil House, Columbus Ohio, Headquarters.

Deshler-Wallick, Columbus, Ohio (one-half square away).

GEORGE M. ANDERSON, Chairman of the Program Committee.

American Board of Orthodontics

The 1948 meeting of the American Board of Orthodontics will be held at the Deshler-Wallick Hotel, Columbus, Ohio, April 23, 24, 25, and 26. Orthodontists who may desire to be certificated by the Board may obtain application blanks from the Secretary, Dr. Bernard G. deVries, 705 Medical Arts Building, Minneapolis 2, Minnesota.

Northeastern Society of Orthodontists

The annual meeting of the Northeastern Society of Orthodontists will be held at the Chalfont-Haddon Hall, Atlantic City, New Jersey, on Monday and Tuesday, March 1 and 2, 1948.

Southwestern Society of Orthodontists

The Southwestern Society of Orthodontists will hold its annual meeting in Wichita, Kansas, Feb. 1, 2, 3, and 4, 1948.

Chicago Association of Orthodontists

The Chicago Association of Orthodontists held a meeting Oct. 27, 1947. The essayist was Wayne B. Slaughter, who spoke on the subject, "The Timing of Surgical Procedures in Congenital Anomalies of the Face."

On Monday evening, November 24, the Association held another meeting at the Bismarck Hotel, and the following men gave case reports:

B. F. Dewel. Discussed by Ralph G. Bengston.

Carlton D. Reed. Discussed by F. J. Krivanek.

Harold Schwartz. Discussed by T. M. Graber.

Cincinnati Dental Society

The Cincinnati Dental Society takes pleasure in the announcement of the Cincinnati Dental Society March Clinic and Children's Dental Health Day, March 14, 15, and 16, 1948, Netherland Plaza Hotel.

Philadelphia Society of Orthodontists

The fall meeting of the Philadelphia Society of Orthodontists was held Oct. 6, 1947, at Hotel Warwick. The essayist was Dr. Clare K. Madden, of Connecticut. The officers elected for the year of 1948 are:

President, Dr. John W. Ross, 1520 Spruce Street.

Secretary, Dr. Augustus L. Wright, 255 South Seventeenth Street.

Orthodontic Directory of the World

The fourteenth edition of the *Orthodontic Directory of the World* is expected to be off the press about April 1, 1948. The editor is Dr. Oren A. Oliver, 1915 Broadway, Nashville, Tennessee.

American Academy of Oral Pathology

The American Academy of Oral Pathology will hold its Second Annual Meeting at the Hotel Stevens, in Chicago, on Sunday, February 8. Among the speakers will be:

Dr. Carl Waldron, University of Minnesota
Dr. B. O. A. Thomas, Washington University, Seattle
Dr. Edward Stafne, Mayo Clinic
Cdr. Carl A. Schlack, Naval Medical Research Institute
Dr. Hamilton B. G. Robinson, Ohio State University
Dr. Barnet Levy, Washington University, St. Louis
Dr. Irving Glickman, Tufts College Dental School
Dr. Henry Goldman, Boston, Massachusetts
Dr. Lester R. Cahn, Columbia University
Dr. Hermann Becks, University of California
Dr. Myron Aisenberg, University of Maryland

The Academy will cooperate with the New England Society of Oral Surgeons and the Seminar of Oral Medicine in sponsoring a new periodical starting January, 1948. The new journal, ORAL SURGERY, ORAL MEDICINE, AND ORAL PATHOLOGY, will be published by The C. V. Mosby Company, St. Louis, and will replace the Oral Surgery Section of the AMERICAN JOURNAL OF ORTHODONTICS AND ORAL SURGERY. Dr. Kurt Thoma, President of the American Academy of Oral Pathology, will be Editor-in-Chief and Editor for the New England Society of Oral Surgeons. Dr. Hermann Becks will be Editor for the Seminar of Oral Medicine, and Dr. Hamilton Robinson will be Editor for the Academy. The JOURNAL will appear in twelve issues per year.

The Academy of Oral Pathology will hold examination for fellowship in the Spring. Early announcement will be made of the exact time and place.

HAMILTON B. G. ROBINSON, Editor
Ohio State University, College of Dentistry, Columbus 10, Ohio.

New Scientific Journal Published at Ohio State University

A new scientific periodical, *The Health Center Journal*, was launched at Ohio State University Monday, Dec. 1, 1947, with publication of the first issue by the faculties of the Colleges of Medicine and Dentistry.

Scientific material in the quarterly journal, which is edited by Dr. Allan C. Barnes, Chairman of the Department of Obstetrics and Gynecology at Ohio State University, includes four research papers by members of the University's medical and dental staffs, a review article, and notes on a clinicopathologic conference.

Also included in the publication are reviews and comments on recent medical articles in nonmedical periodicals, notes on the College of Dentistry and the departments of the College of Medicine, messages from the deans of the two colleges, proceedings of the Society for Clinical Research, and a book review section.

The periodical will be distributed to medical and dental faculty members, to alumni of the two colleges, whose alumni dues cover the annual subscription rate of $2.00, and to other subscribers. Single copy price is fifty cents.

Associate editors of the journal are: Dr. Hamilton B. G. Robinson, Dr. Jonathan Forman, and Dr. Charles A. Doan, Dean of the College of Medicine.

Editorial board members include Dr. George M. Curtis, Dr. Grant O. Graves, Dr. Benjamin C. Houghton, Dr. Paul C. Kitchin, Dr. Russel G. Means, Dr. Milton M. Parker, Dr. George H. Ruggy, Dr. Emmerich von Haam, Dr. Warren E. Wheeler, and Dr. Robert M. Zollinger. Dorothy V. Allonier is Editorial Assistant.

Notes of Interest

Albert C. Mogler, D.D.S., Pasteur Medical Building, St. Louis 8, Missouri, announces the association of Paul E. Spoeneman, D.D.S., practice limited to orthodontics.

OFFICERS OF ORTHODONTIC SOCIETIES

The AMERICAN JOURNAL OF ORTHODONTICS AND ORAL SURGERY is the official publication of the American Association of Orthodontists and the following component societies. The editorial board of the AMERICAN JOURNAL OF ORTHODONTICS AND ORAL SURGERY is composed of a representative of each one of the component societies of the American Association of Orthodontists.

American Association of Orthodontists

President, Earl G. Jones - - - - - - - - - - - 185 East State St., Columbus, Ohio
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Vice-President, G. Vernon Fisk - - - - - - 818 Medical Arts Bldg., Toronto, Ont., Can.
Secretary-Treasurer, Max E. Ernst - - - - 1250 Lowry Medical Arts Bldg., St. Paul, Minn.

Central Section of the American Association of Orthodontists

President, Ralph G. Bengston - - - - - - - - - 25 E. Washington St., Chicago, Ill.
Secretary-Treasurer, Earl E. Shepard - - - - - - - - - 4500 Olive St., St. Louis, Mo.

Great Lakes Society of Orthodontists

President, Elmer F. Boester - - - - - - - - - - 1821 Republic Bldg., Cleveland, Ohio
Secretary-Treasurer, Scott T. Holmes, 509 Hackley Union National Bank Bldg., Muskegon, Mich.

Northeastern Society of Orthodontists

President, John W. Ross - - - - - - - - - - - - 1520 Spruce St., Philadelphia, Pa.
Secretary-Treasurer, Oscar Jacobson - - - - - - - - 35 W. 81st St., New York, N. Y.

Pacific Coast Society of Orthodontists

President, S. B. Hoskins - - - - - - - - - - - Medical Dental Bldg., Portland, Ore.
Secretary-Treasurer, Frederick T. West - - - - - 870 Market St., San Francisco, Calif.

Rocky Mountain Society of Orthodontists

President, Fred Bowden - - - - - - - - - - - - - Republic Bldg., Denver, Colo.
Vice-President, Harry V. Banks - - - - - - - - - - - 1550 Lincoln, Denver, Colo.
Secretary-Treasurer, Elmer S. Linderholm - - - - - - - 1558 Humboldt, Denver, Colo.

Southern Society of Orthodontists

President, Neil J. Leonard - - - - - - - - - - - - Exchange Bldg., Memphis, Tenn.
Secretary, Leland T. Daniel - - - - - - - - - - - - American Bldg., Orlando, Fla.

Southwestern Society of Orthodontists

President, R. E. Olson - - - - - - - - - - - - - - 712 Bitting Bldg., Wichita, Kan.
Secretary-Treasurer, Marion A. Flesher - - - Medical Arts Bldg., Oklahoma City, Okla.

American Board of Orthodontics

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Secretary, Bernard G. deVries - - - - - - - Medical Arts Bldg., Minneapolis, Minn.
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Reuben E. Olson - - - - - - - - - - - - 712 Bitting Bldg., Wichita, Kan.

A List of the Orthodontic Societies of the World and Their Principal Officers*

Chicago Association of Orthodontists

President, Ernest Myer - - - - - - - - - - - - 180 N. Michigan Ave., Chicago, Ill.
President-Elect, B. F. Dewel - - - - - - - - - - - 708 Church St., Evanston, Ill.
Secretary-Treasurer, Howard J. Buchner - - - - - - - - 1011 Lake St., Oak Park, Ill.

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Vice-President, Sidney P. Stone - - - - - - - - 21 Columbia Rd., Dorchester, Mass.
Secretary-Treasurer, Harold J. Nice - - - - - - 475 Commonwealth Ave., Boston, Mass.

New York Society for the Study of Orthodontics

President, Myron Mage - - - - - - - - - - - - 225 W. 86th St., New York, N. Y.
Vice-President, Abbey E. Weinstein - - - - - - 25 Central Park West, New York, N. Y.
Secretary-Treasurer, H. Allen Bimston - - - - - 1882 Grand Concourse, New York, N. Y.

New York University Orthodontic Society

President, Robert J. DiTolla - - - - - - - - - - 5 E. 53rd St., New York, N. Y.
Secretary-Treasurer, Benjamin Ackerman - - - - - 7616 Bay Parkway, Brooklyn, N. Y

Philadelphia Society of Orthodontists

President, John W. Ross - - - - - - - - - - - 1520 Spruce St., Philadelphia, Pa.
Secretary, Augustus L. Wright - - - - - - - - - 255 S. 17th St., Philadelphia, Pa.

St. Louis Society of Orthodontists

President, Leo M. Shanley - - - - - - - - - - 7800 Maryland Ave., Clayton 5, Mo.
Vice-President, Earl Sheppard - - - - - - - - - - 4500 Olive St., St. Louis, Mo.
Secretary-Treasurer, Everett W. Bedell - - - - - 1504 S. Grand Blvd., St. Louis 4, Mo.

Washington-Baltimore Society of Orthodontists

President, Edwin Tupper Rice - - - - - - - 900 17th St., N. W., Washington 6, D. C.
Vice-President, Hammond L. Johnston - - - - - - - 828 Park Ave., Baltimore 1, Md.
Secretary-Treasurer, Carlotta A. Hawley - - - - - 915 19th St., Washington 6, D. C.

Foreign Societies

British Society for the Study of Orthodontics

President, M. W. Rushton - - - - - - - - - - - Guy's Hospital, S. E. 1, London
Secretary, K. E. Pringle - - - - - - - - - - - 12 Manchester Square, W.1, London
Treasurer, Harold Chapman - - - - - - - - - 6 Upper Wimpole St., W.1, London

Sociedad Argentina de Ortodoncia

President, Vicente A. Bertini - - - - - - - Constitucion 1239, San Fernando, F.C.C.A.
Secretary, Ludovico E. Kempter - - - - - - - - - Paraguay 577, Buenos Aires
Treasurer, Edmundo G. Locci - - - - - - - - - - Uruguay 763, Buenos Aires

*In the January issue of the AMERICAN JOURNAL OF ORTHODONTICS AND ORAL SURGERY is published each year a list of the orthodontic societies of the world of which the JOURNAL has any record, along with the names and addresses of their principal officers.

The JOURNAL keeps a file for each of these societies and publishes the names that appear in that file as of the date of going to press.

Sociedad Brasileira de Ortodoncia

President, Joaquim Cavalcanti - - - - - - - Praca G. Vargas 2, S. 422, Rio de Janeiro
Vice-President, Kant Duarte - - - Rua Manuel de Carvalho, 16-9°, S. 91, Rio de Janeiro
Secretary, Virgilio Moozen - - de Oliverira, Av. Rio Branco 311-6°, S. 613, Rio de Janeiro

Sociedad de Ortodoncia de Chile

President, Rafael G. Huneeus - - - - - - - - - - San Martin No. 133, Santiago
Vice-President, A. Arturo Toriello - - - - - - - - - - Londres No. 63, Santiago
Secretary, Juan Colin Montandon - - - - - - - - - San Martin No. 133, Santiago
Treasurer, Pedro Gandulfo Guerra - - - - - - - - - - Londres No. 63, Santiago

Sociedad Colombiana de Ortodoncia

President, José Mayoral - - - - - - - - - - - - - Carrera 9, No. 21-68, Bogota
Vice-President, Obdulio Mendez - - - - - - - - - - - Calle 12, No. 15-06, Bogota
Secretary-Treasurer, Marco Novoa - - - - - - - - - - Calle 11, No. 17-30, Bogota

Cuban Association of Orthodontists

President, Carlos Coro - - - - - - - - - - - - - - - - Virtudes 618, Habana
Vice-President, Dario Gandarias - - - - - - - - Calle 25, No. 954, Vedado, Habana
Secretary-Treasurer, Dra. Margarita Amézaga - - - - - - - - Virtudes 618, Habana

Guatemalan Association of Orthodontics and Relative Sciences

Secretary, Enrique Estrada H. - - - - - - Apartado de Correos No. 110, Guatemala

Asociación Méxicana de Ortodoncia

President, Guillermo Gamboa - - - - - - - - - - - - - Madero 34, Mexico City
Secretary, Rutilio Blanco - - - - - - - - - - - - - - Donceles 98, Mexico City
Treasurer, Carlos M. Paz - - - - - - - - - - - - - - Insurgentes 72, Mexico City

Sociedad Peruana de Ortodoncia

President, Augusto Taiman - - - - - - - - - - - - - - - Arzobispo 284, Lima
Vice-President, Ricardo Salazar - - - - - - - - - - - - - Edificio Olaya 38, Lima
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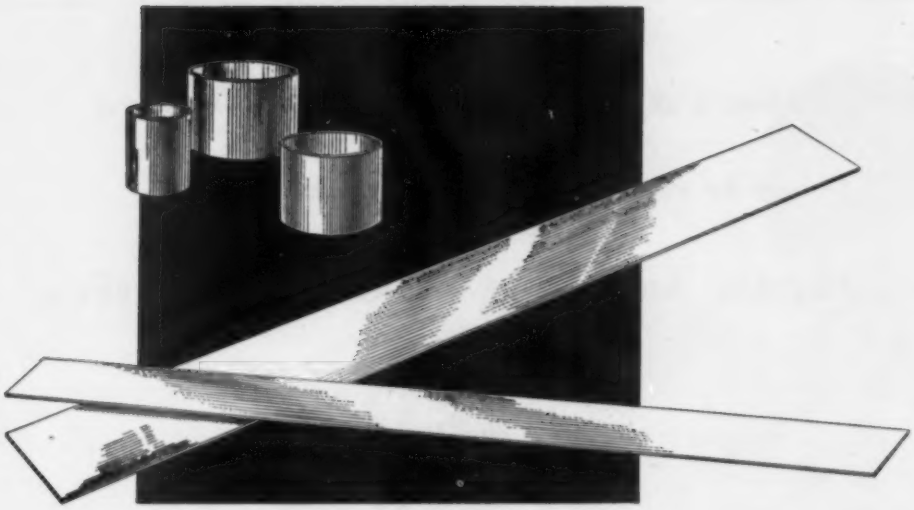

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Articles to appear in early issues of

Oral Surgery, Oral Medicine, and Oral Pathology

LEUCEMIA, Thomas J. Cook, Miami, Fla.

MASSACHUSETTS GENERAL HOSPITAL NUMBER. The Clinic of the Dental Department of the Massachusetts General Hospital and the Department of Oral Surgery of the Harvard School of Dental Medicine. Volume IX. Kurt H. Thoma, Daniel J. Holland, Jr., Howard W. Woodbury, Jarrel G. Burrow, and Edward L. Sleeper.

I. Oral Conditions With a Background of Systemic Diseases.

II. Salivary Cysts.

III. Gelatin Sponge in the Obliteration of Cavities Resulting from the Excision of Cysts and Tumors of the Jaws.

IV. Contribution to the Oncology of the Jaws.

V. Diagnosis of Oral Epidermoid Carcinoma.

VI. Osteomyelitis of the Jaws.

VII. An Analysis of One Hundred Thirty Recently Treated Fractures.

VIII. Fracture Cases Treated by Means of Internal Fixation.

IX. Experiments With Wiring Mandibular Fixation of the Jaws.

X. Deformities of the Jaws.

Volume I, Number 1. **January, 1948**

This new publication is the outgrowth of the "Department of Oral Surgery" in the present "American Journal of Orthodontics and Oral Surgery," which has been a part of the latter periodical almost continuously since March, 1919. Thus, it will appear, even in its very first issue, as a mature, fully developed journal, enjoying both a thoroughly experienced editorial management and an established and substantial readership.

As is indicated above, the new journal will have sections on oral medicine and oral pathology, and will represent societies of specialists in the three fields covered. Additional members of the editorial board will be announced later. The monthly issues will comprise one annual volume, which will total approximately nine hundred pages. The subscription rate will be $8.50 for domestic or Latin-American Service, and $9.50 for countries outside the Pan-American Postal Union.

Due to the fact that paper is still in short supply, printings of the early issues will be limited to the active subscription list, and so it is suggested that all dentists who would like to have a complete file of the new journal, order it before publication.

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AMERICAN JOURNAL OF ORTHODONTICS

Published by THE C. V. MOSBY COMPANY, 3207 Washington Blvd.
St. Louis 3, U. S. A.

Entered at the Post Office at St. Louis, Mo., as Second Class Matter.

Published Monthly. Subscriptions may begin at any time.

Official Publication of The American Association of Orthodontists,
its components societies and The American Board of Orthodontics

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Manuscripts should be typewritten on one side of the paper only, with double spacing and liberal margins. References should be placed at the end of the article and should include, in the order given, name of author, title, journal, volume, pages, and year; e.g., Smith, E. J.: Children's Dentistry, Am. J. Orthodontics, 34: 1-25, 1947. Illustrations accompanying manuscripts should be numbered, provided with suitable legends, and marked on margin or back with author's name. Articles accepted for publication are subject to editorial revision. Neither the editors nor the publishers accept responsibility for the views and statements of authors as published in their "Original Communications."

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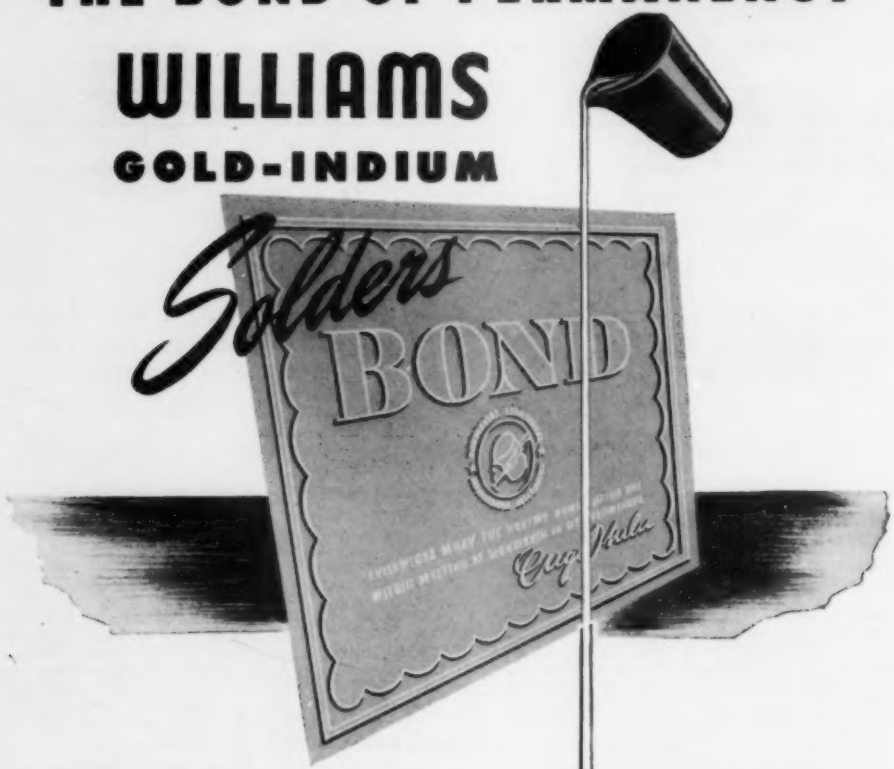

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OFFICIAL PUBLICATION OF THE INTERNATIONAL ASSOCIATION FOR DENTAL RESEARCH

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